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Mobile Radio Technology

The journal of mobile communications technology

Antenna test ranges, p. 10

ERMES paging code

Field intensity units

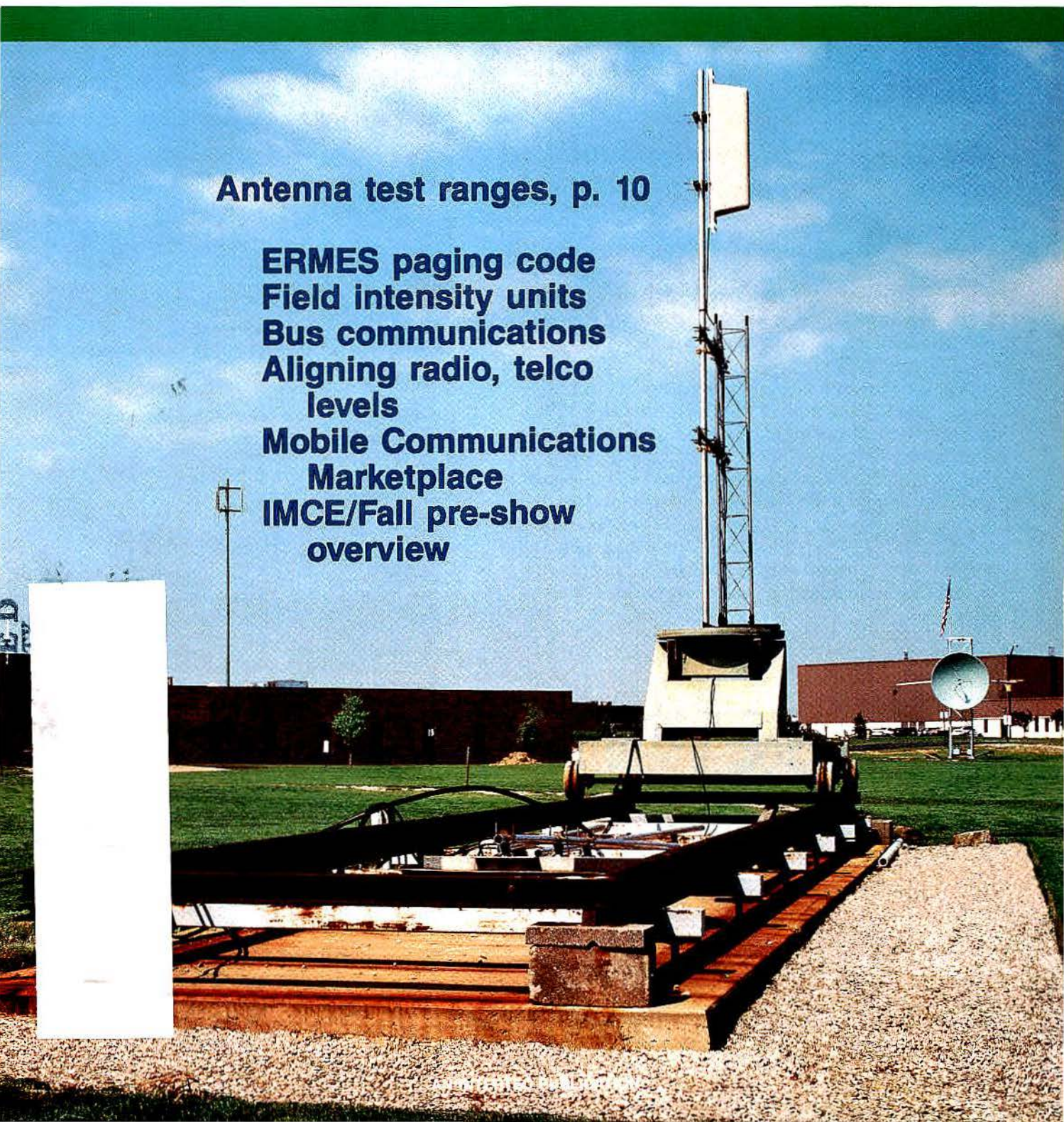
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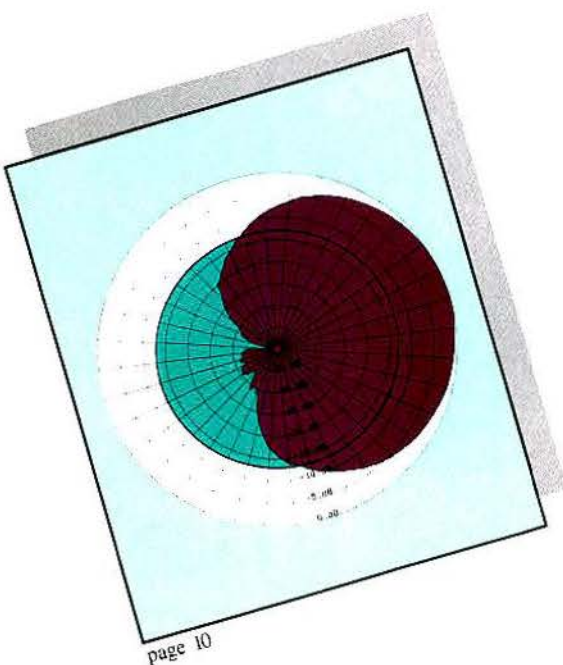
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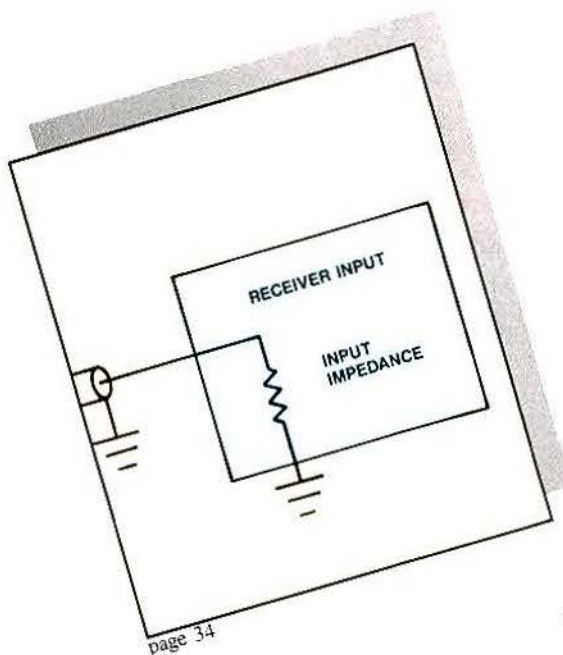
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On the cover: The test range at Antenna Specialists, Solon, OH, develops antenna specifications used by technicians and engineers to design radio communications systems. See Andrew Singer's article on page 10.



page 10



page 34

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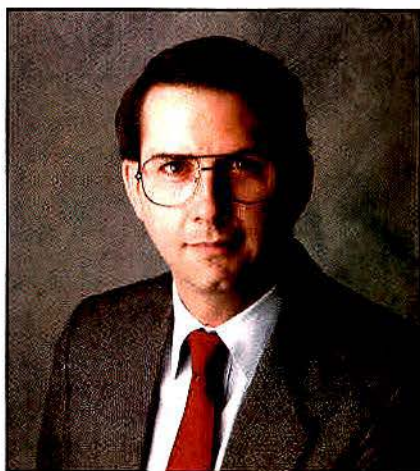
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Circle (5) on Fast Fact Card

Scanning . . .



End-user licensing

An FCC proposal to eliminate end-user licensing for specialized mobile radio (SMR) users offers more advantages than disadvantages.

► **Advantage**—Paperwork for system operators and their customers will be reduced.

► **Advantage**—Eliminating end-user licensing means system operators no longer would have to ask roaming customers to apply for licenses on other operators' systems. (For operators that do not currently ask their customers to get licenses to use other operators' systems, the change will legitimize a practice that otherwise could become an embarrassment or a legal problem.)

► **Advantage**—User fees, if and when they are enacted, may be reduced for SMR operators because their proportion of government license application processing expense would be reduced.

► **Disadvantage**—On the other hand, SMR operator user fees may be higher because of increased government expenses in processing the type of loading statements they would be required to file.

► **Advantage or disadvantage**—Depending on your perspective, possible changes in how loading is counted and reported may be an advantage or a disadvantage.

For operators that have overstated loading in the past by counting inactive

(or non-existent) licensed users, a certified statement of customers backed with billing records may be more difficult and risky to falsify. That is a disadvantage for them and an advantage for operators that follow the rules. Accurate loading reports allow channels to be assigned fairly.

One plan for counting customers would allow each operator to count a customer once per system, wherever the customer roams. The present requirement is to count the customer once for the "home" system and not to count the customer again on any other systems.

The multiple-counting plan favors multiple-system operators. It would boost their loading counts and allow them to ask for more channels than they would qualify for otherwise.

Smaller SMR operators with fewer systems would continue to find channels in short supply.

Thus, the advantage or disadvantage in how SMR customers are counted for loading depends on the number of systems the SMR operator has.

► **Disadvantage**—One way of defending the position that SMR systems should be licensed as private carriers may be weakened without end-user licensing. SMR system operators currently benefit from private carrier status, which exempts them from state regulation.

* * *

Milestone

Cellular mobile telephone service has been extended into all 734 market areas defined by the FCC.

The 734th market to receive service is in Mississippi, and the area served by the cellular system in that market is in Granada County. Service was activated in late May.

As of Dec. 21, 1991, there were 7.6 million cellular subscribers in the United States, according to figures released by the Cellular Telecommunications Industry Association, Washington, DC. The association estimated that

there would be 8.8 million subscribers by June 30 this year.

CTIA estimates the industry has created as many as 100,000 new jobs since 1983.

* * *

Vipers

The FCC has issued a *Report and Order* changing the name of the Motion Picture Radio Service (MPRS) to the Video Production Radio Service (VPRS).

This action, along with others taken in the same proceeding, does not sit well with the Alliance of Motion Picture and Television Producers, a trade association with members who generally are eligible for licenses in VPRS.

We think the alliance has a point when it says that a better name would be the Motion Picture and Television Radio Service (MPTRS). A little better, anyway. It isn't too easy to fit our mind around a "television radio" service, but we can do it.

Still, we like the way the radio service's acronym is pronounced: *vipers*!

—Don Bishop

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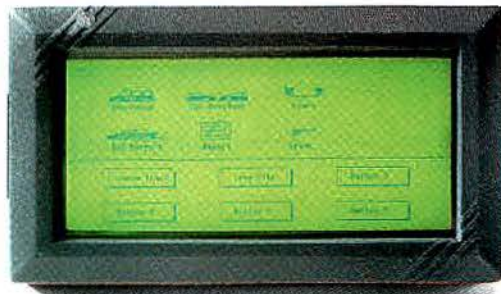
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Tower lighting:

Although I enjoyed reading my good friend Lew Wetzel's article "Using White Lights To Mark Radio Towers" in your June issue, some response is necessary to some of the article's points.

The article reads "... the real drawback of white strobe beacons is the dispersion of light through their Fresnel lenses.... The Fresnel lens was designed for point sources of light, not the light radiated from a large helical flashlamp."

Fresnel lenses for strobes or light-houses and parabolic reflectors for strobes indeed are designed for point sources of light. That point source is considered to be the optic center of the light source.

In the early Fresnel lenses and early parabolic reflectors in lighthouses, that light source was an oil lamp and, later, a carbon arc. The reality was, and is, that no available light source truly is a

point light source.

Any xenon flashtube, whether linear or helical, has some inside diameter enclosing glowing gas, the light of which unavoidably is refracted somewhat by the glass envelope surrounding it.

Any optical system, whether parabolic reflector or Fresnel lens, will, with a flashtube having a measurable diameter, cause some light to be dispersed slightly outside the intended beamwidth.

Care is taken to fix the optic center of the flashtube at the focal point of the optic. At the center of the TWR Lighting helical flashtube is a vertical (light-emitting) leg of the tube itself. The ratio of tube diameter to the distance between the focal point and optic (lens or reflector) is similar for both types of systems.

The Fresnel lens used by TWR Lighting for its medium-intensity strobe system is designed to produce a narrow beam from a discrete light source,

whether discharge or incandescent.

Even assuming high efficiency for the EG&G reflector, some light inevitably will be scattered by the flashtube-reflector-cover system owing to unreflected light from the tube itself, scatter off the reflector edges and refraction by the cover plastic.

The article's Figures 1 and 2 clearly exaggerated the inefficiency of the Fresnel lens and the efficiency of the parabolic reflector in production of scattered light.

All approved L-865 medium-intensity strobe systems are required to have a vertical beam spread specified as "3° minimum," and all units, Fresnel lens or parabolic reflector, must maintain "the lower edge of the vertical beam spread...between -1.5° and -0.5°." Intensities are specified as 20,000 candela $\pm 25\%$ in the daytime and 2,000 candela $\pm 25\%$ at night.

Degradation of light output in older

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The journal of mobile communications technology

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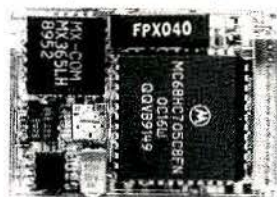
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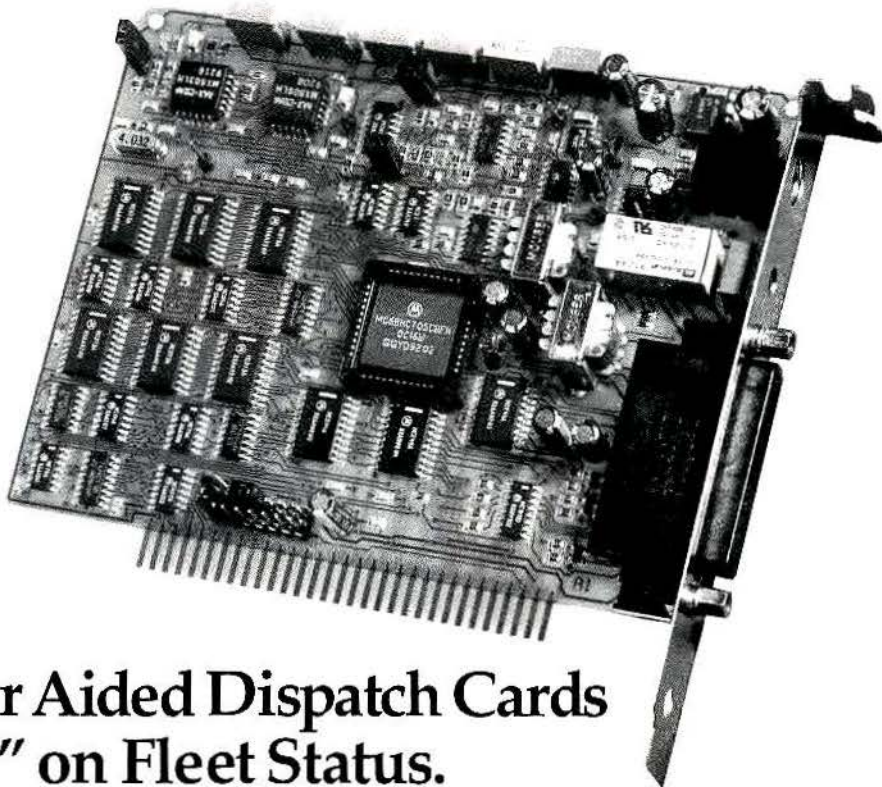
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Circle (7) on Fast Fact Card

Letters to the editor

strobe systems has been less a function of the helical-Fresnel nature of the systems than of the materials used in the tubes themselves. The culprits have been ultraviolet (UV) light and ozone.

Corona in the trigger wire was caused by corrosion owing to the ozone produced by the tubes. Special quartz glass in current tubes and a glass shield surrounding the tube helix successfully

have addressed these problems.

Advanced acrylic materials are used in the Fresnel lens of the TWR strobe system. The lens is UV resistant and, according to the manufacturer, stable to an ambient temperature as high as 80°C, although few radio towers are subjected to 176°F ambient temperatures.

The lens itself originally was developed some years ago for marine navigation

aids and is designed to serve for many years in some of the harshest environments.

Although the new reflector strobe system has not been operating long enough to provide accurate lamp life data, the chance of failure is tripled in such a three-flashlamp system because all three flashlamps are necessary for system operation.

Unfortunately, no flashtubes, reflectors, optic covers or red or white lenses are bulletproof. Repair of any beacon is expensive.

Medium-intensity strobes indeed are the most economical option to red lights, painting or both. Any approved, properly installed system will not create a scatter light problem and will remain a good neighbor.

Patrick Feller
General Manager
TWR Lighting
Houston

Lew Wetzel's response to Patrick Feller's letter is too long to include in this month's letters column. It will appear next month.

His response reads that Figures 1 and 2 are not exaggerated, and he includes the equation used to calculate beam spread. His letter cites the results of ozone and acrylic temperature tests and makes a statement about flashlamp life.

—DB

Fast Fact Card comment:

I would like to see more articles with more technical meat for the service technician. How about a clearinghouse section for the sharing of problems encountered or solved?

The toughest problems facing me on the job include:

- lowband propagation.
- companies that release radios before their time, causing technicians in the field to work out the "bugs" for them.

Darrel L. Nichols
Missouri State Highway Patrol
Lee's Summit, MO

Readers, would you contribute to a clearinghouse section, such as Darrel Nichols describes?

—DB

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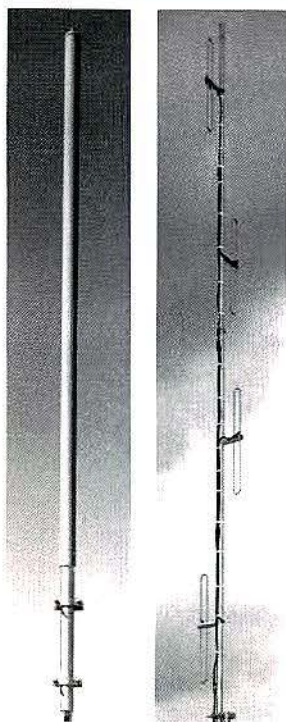
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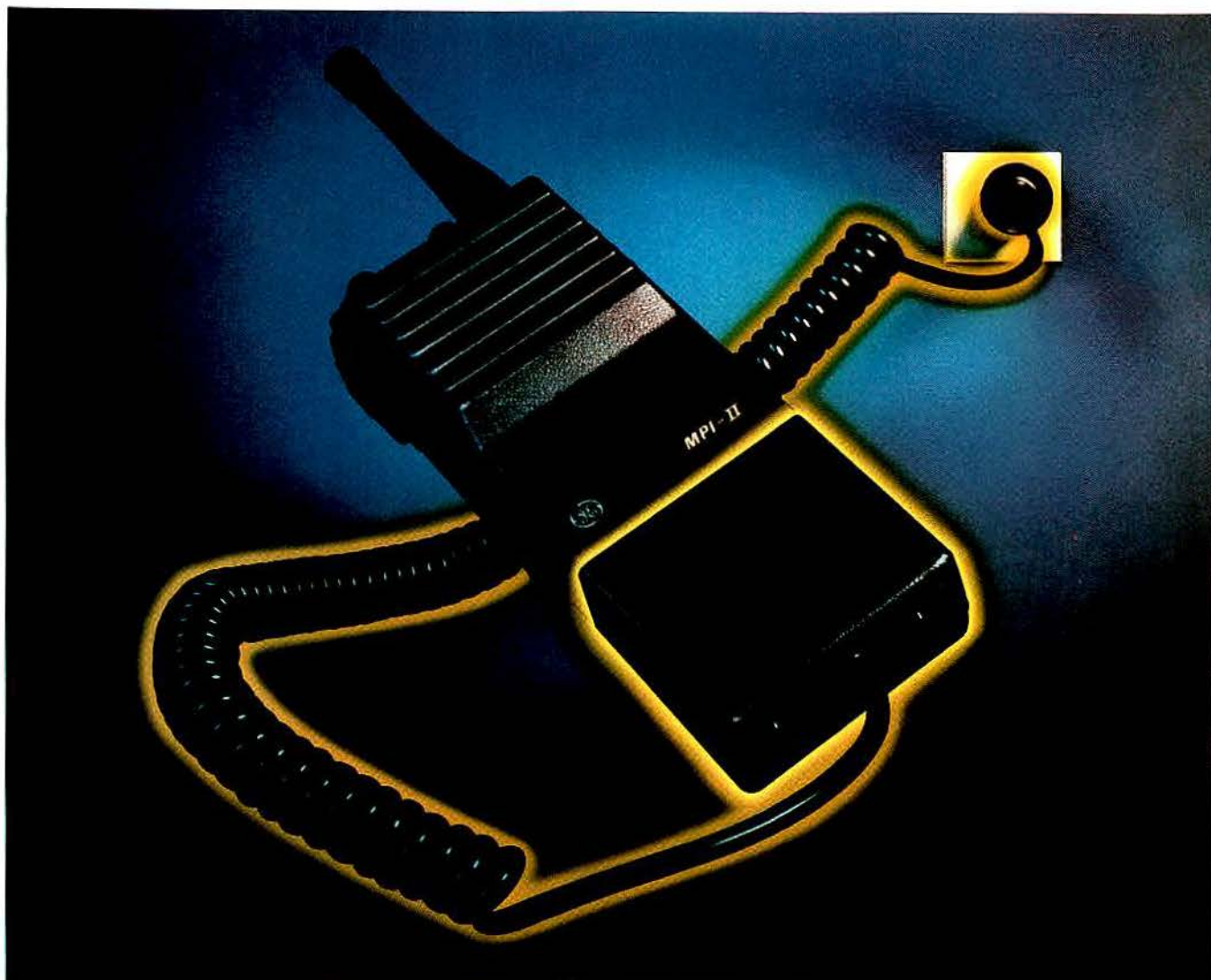
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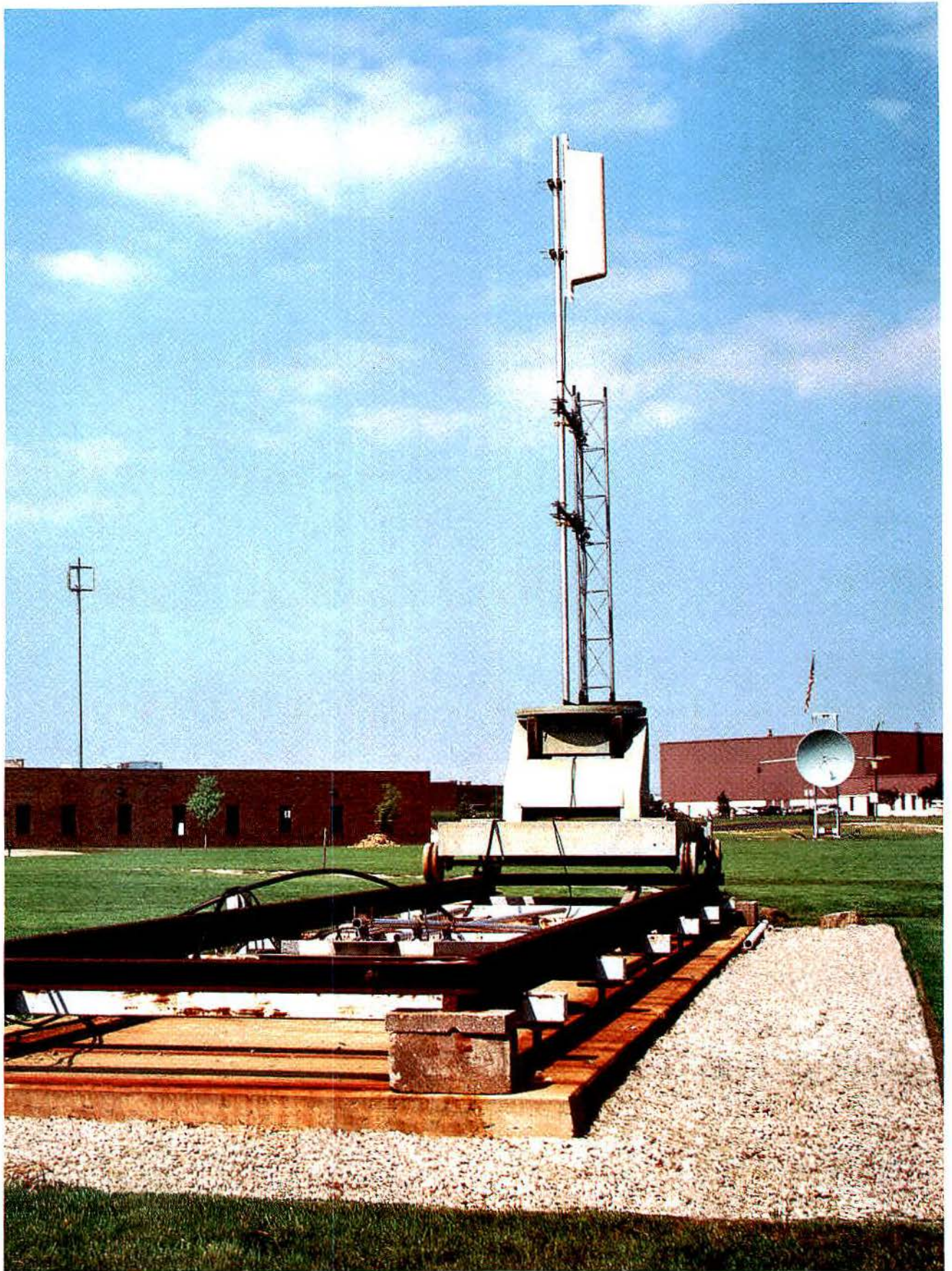
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Antenna test ranges develop accurate specifications

Knowing how antenna specifications are developed on test ranges helps technicians and engineers to use them in designing radio communications facilities. Field results can differ from test range results.

By Andrew Singer

Every time you read a mobile or base antenna advertisement or try to design a new system, you cannot help but notice antenna performance specifications such as gain, beamwidth and front-to-back ratio.

Technicians and engineers who are unfamiliar with antenna design often question the source of these specifications. Are they the latest marketing voodoo, or did somebody in sales fabricate them?

Technicians prefer specifications developed on a well-planned antenna range and measurement system, although too often that is not the source.

A good antenna range measures antenna specifications properly, making it

possible to choose the most efficient antenna for a particular application, which leads to better system performance.

Because achieving better system performance is part of many technicians' and engineers' jobs, an understanding of antenna measurements is important.

Key antenna characteristics are gain, pattern, voltage standing wave ratio (VSWR) and polarization.

► **Gain**—An antenna's power gain is the ratio of its maximum radiation intensity in a stated direction to the maximum radiation intensity of a lossless reference antenna with identical input power.

Thus, gain is a measure of the antenna's efficiency. Antenna gain can be achieved only by narrowing the antenna pattern in one or more planes. For instance, an omnidirectional antenna provides increased gain by narrowing the vertical beamwidth.

To increase the gain of a 9dBd om-

nidirectional antenna with a 6° vertical beamwidth to 12dBd, the vertical beamwidth must be reduced to 3.5° or less, and the antenna's length must double (to approximately 20 feet).

Halving the vertical beamwidth increases the gain by 3dB, excluding losses.

Gain is measured in comparison with a reference antenna. For VHF and UHF base station antennas, gain usually is measured in comparison with a half-wave dipole. To make this clear, the unit of measurement is expressed as dBd. The d after dB indicates the use of a dipole reference antenna.

Another reference antenna is an isotropic radiator. This reference antenna commonly is used in expressing microwave antenna gain, and it is indicated by the unit dBi.

To convert VHF and UHF antenna gain specifications expressed in dBi to the commonly accepted dBd reference,

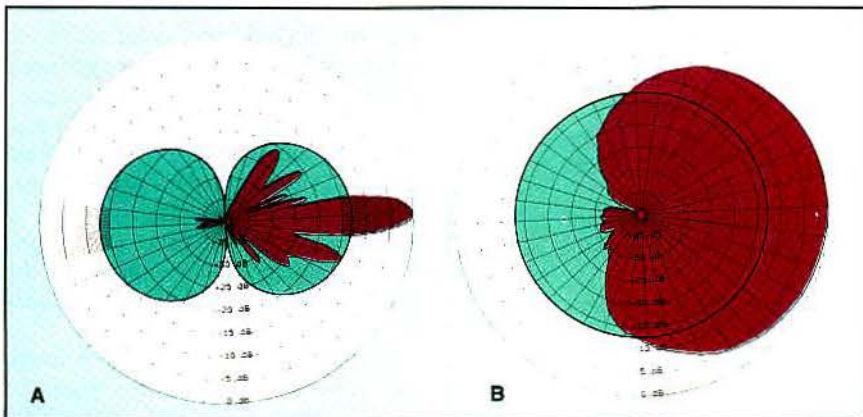


Figure 1. Antenna radiation pattern graphs show the relative field strength magnitude an antenna radiates in the vertical (A) and horizontal (B) planes. This example shows patterns for a 110° sector log periodic antenna (purple) and a reference dipole antenna (blue).

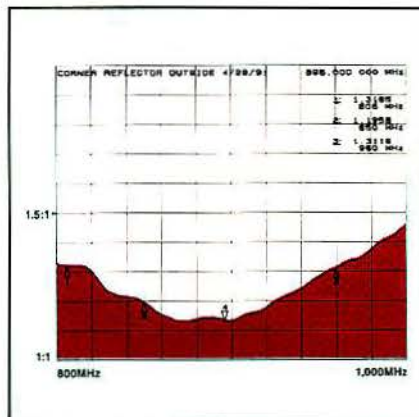


Figure 2. A VSWR curve from 800MHz to 1,000MHz for an antenna with a VSWR that does not exceed 1.5:1 within the frequency range.

Singer is antenna product manager at Antenna Specialists, Solon, OH.

subtract 2.15dB. If the specifications are in dB, ask the manufacturer whether a dipole or an isotropic antenna was used as a reference, and adjust the figure accordingly.

► **Pattern**—An antenna's radiation pattern is difficult to measure and interpret.

A radiation pattern is a graph of the relative field strength magnitude an an-

tenna radiates in a given plane. (See Figure 1 on page 11.)

The pattern shows the direction where the antenna "concentrates" the radio energy. These patterns typically are measured and graphed in both the vertical and horizontal planes.

The patterns are used to determine specifications such as beamwidth and front-to-back ratio.

► **VSWR**—The ratio of maximum to minimum voltage along a lossless 50Ω line with an antenna as a load is the VSWR.

It is convenient to think of VSWR as a quality factor that determines how efficiently radio energy transfers to the antenna. VSWR does not affect the antenna's radiation pattern characteristics.

The industry-accepted value for base station antenna VSWR is 1.5:1 or less across the operating frequency band.

VSWR standards for mobile antennas vary.

A typical VSWR curve is shown in Figure 2 on page 11.

An antenna test range is not required to measure VSWR properly. The only requirement is that the antenna be in a free-space environment when checking VSWR. This is accomplished by isolating the antenna from nearby objects such as buildings, towers and other antennas mounted nearby (such as on a car) that can detune the antenna being measured.

► **Polarization**—Generally, not much is said about antenna polarization because the vast majority of land mobile antenna applications use vertical polarization because vertical antennas lend themselves to mounting on cars.

Antenna polarization is the electric field vector orientation of the radio wave the antenna radiates. A visual inspection usually reveals an antenna's polarization.

For instance, a metal dipole array with all its elements perpendicular to the ground and a properly mounted on-glass cellular antenna is vertically polarized.

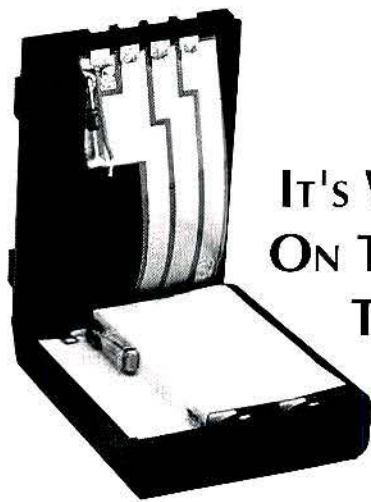
With antenna characteristics of gain, pattern, VSWR and polarization in mind, antenna test range measurements can be reviewed.

Three basic elements in a good range are acceptable phase error, uniform field amplitude and a standard gain antenna.

► **Acceptable phase error**—To achieve an acceptable phase error, a certain minimum distance between the source antenna and the antenna under test (AUT) is necessary.

Illumination from the source antenna should be a plane wave over the AUT's effective aperture. A uniform plane wave includes uniform amplitude and phase.

Phase variations of as much as 18° are acceptable. To achieve a field this uni-



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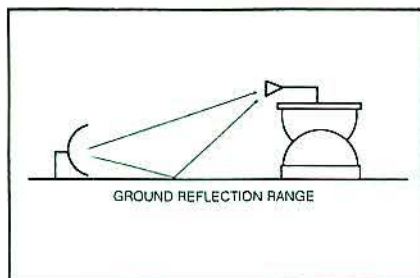
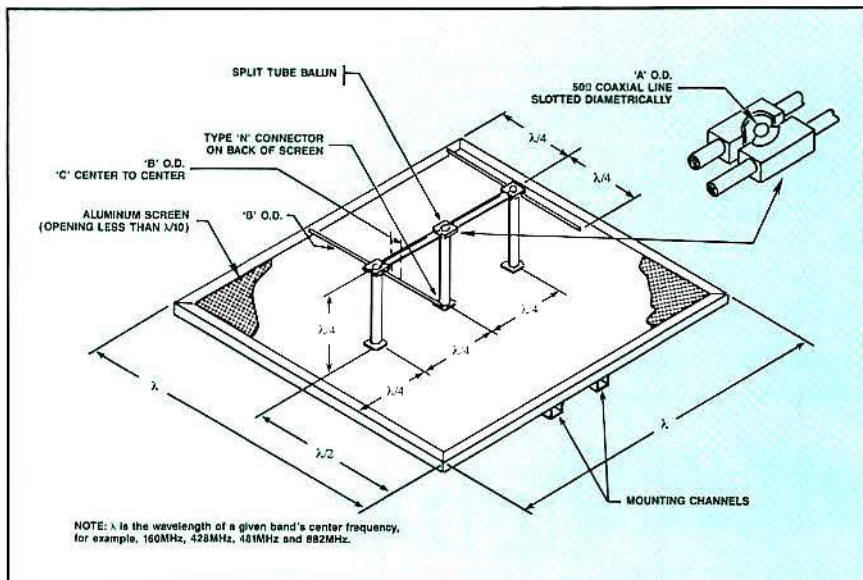


Figure 3. (Above.) A ground-reflection test range places the antenna near ground level so that the reflected energy adds constructively to produce an acceptably uniform phase and amplitude front at the antenna under test.

Figure 4. Base station antenna measurements should be compared to measurements with an EIA-329-A standard dipole antenna, such as the one diagramed at the right.



form, the antenna under test needs to be a minimal distance of $2D^2/\lambda$ from the source. This is a minimal distance requirement. By keeping the range as short as possible, consistent with maintaining an acceptable phase error, few-

er reflections and a higher dynamic range result.

► *Uniform field amplitude*—Field variations can be produced by interference of the direct wave with waves that are reflected from the ground or from

other objects.

To adhere to the Electronic Industries Association's EIA-329-A standard for antenna measurements, field intensity variations must be less than 0.75dB. This field amplitude uniformity level is ac-

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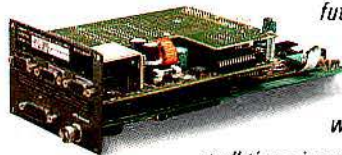
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Keeping data on the move

completed in different ways depending on the antenna range type.

Keeping the range clear of obstructions is important. The antenna range view in the cover photograph shows buildings and structures nearby, but they are behind the source antenna. A view from the source antenna downrange would show no nearby structures.

► **Standard gain antenna**—AUT gain

is measured against a standard gain antenna as a transfer standard reference.

Using these three elements properly helps to assure some degree of accuracy in making gain measurements on any type of range.

Two range types

Two basic antenna range types used for VHF and UHF frequencies are

elevated and ground-reflection ranges.

An elevated range is used in an effort to *suppress* reflected radio energy. A ground-reflection range *controls* reflected energy.

Most land mobile antenna companies use a ground-reflection range (See Figure 3 on page 14.) Some manufacturers use a ground-reflection range because it is impractical to raise the type of antennas being measured high enough to assure accurate measurements on an elevated range.

On a ground-reflection range, the antenna is placed near ground level so that the reflected energy adds constructively to produce an acceptably uniform phase and amplitude front at the AUT. The height, distance of the antennas or both can be adjusted to make sure that the direct and reflected waves add in phase at the AUT and to make sure that the AUT is in free space.

The length of the range shown on the cover is approximately 300 feet to make sure the AUT is far enough away to meet the $2D^2/\lambda$ minimal distance requirement. Several precautions are taken to make certain that amplitude field variations are as small as possible.

A low side-lobe source antenna is used to reduce reflected waves, as well as to isolate any unwanted signals from the range.

The area beyond the receive site is kept clear to a distance equal to one-half of the range distance.

Flat, grassy terrain is used to reduce reflections.

The range can be used for measurements on the VHF, UHF, 800/900MHz and 2GHz frequency bands.

Source antennas on the test range include:

VHF	LPDA
UHF	10' parabolic dish
800/900MHz	10' parabolic dish
2GHz	10' parabolic dish

The parabolic dish is fitted with an LPDA feed.

Gain transfer standards are prepared in accordance with EIA standard EIA-329-A. Figure 4 on page 14 shows an EIA-329-A standard dipole antenna.

Figure 5 on page 20 is a range equipment block diagram. The HP83621A source is the fastest available sweeper source.

If you ever DF from 25 to 1000 MHz and need to do it unobtrusively, you'll want the TD-L8630P-II



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for covert operation a special flat antenna is mounted directly on the main unit. Bearing is indicated by a circular LED display and a meter shows field strength. Spare rechargeable battery,



charger and carrying case are included. Police, defense, security, and other intelligence operators no longer have to worry about jammed communications. If you need to locate interference or other RF source, the 8630P-II is the tool for you. And hardly anyone will notice. Send for complete information today, or call toll-free 1-800-426-5565.

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Unipage Is now a Motorola Company.

Rumors have been circulating for some time that Unipage and Motorola were discussing different business alternatives. As our discussions progressed, the positive nature of an acquisition became an attractive alternative to both Unipage and Motorola.

On June 22nd, 1992, Motorola purchased 100 percent of the Unipage stock from its founders.

Why did Unipage want to become a Motorola Company?

As Unipage grew, the founders foresaw the need for more financial resources and more technological depth than was possible as a small company. At the same time they saw the potential for increased domestic sales and the opportunity to participate in the expanding international market for paging systems. Motorola resources will help make the Unipage product offering stronger, and they have the distribution channels to reach the international markets.

Benefits for you as a Unipage owner.

Instead of being a small independent company, Unipage is now a subsidiary of the largest supplier of equipment to the paging industry.

Unipage will continue to serve the industry as it has in the past. We will continue to provide the same excellent support and reliable, affordable products as before. The people at Unipage will remain the same helpful team that takes pride in the quality service that they provide.

The same, only better.

The Unipage product line will remain the same, reliable terminal that the industry has come to know. In the future as Unipage continues to grow, so will the applied technology and resultant product capability we will be able to offer our customers. The depth and breadth of Motorola will have a positive impact on the products and services that Unipage offers. The Dallas area is our home, and we plan to continue operations from this area.

The marriage of these two companies combines the paging terminal expertise of Unipage with the broad paging product lines of Motorola. This provides the industry with a single supplier for all paging infrastructure equipment, pagers, and services including system design, program management, installation, system optimization, ongoing maintenance and support.

We are excited about becoming A Motorola Company.

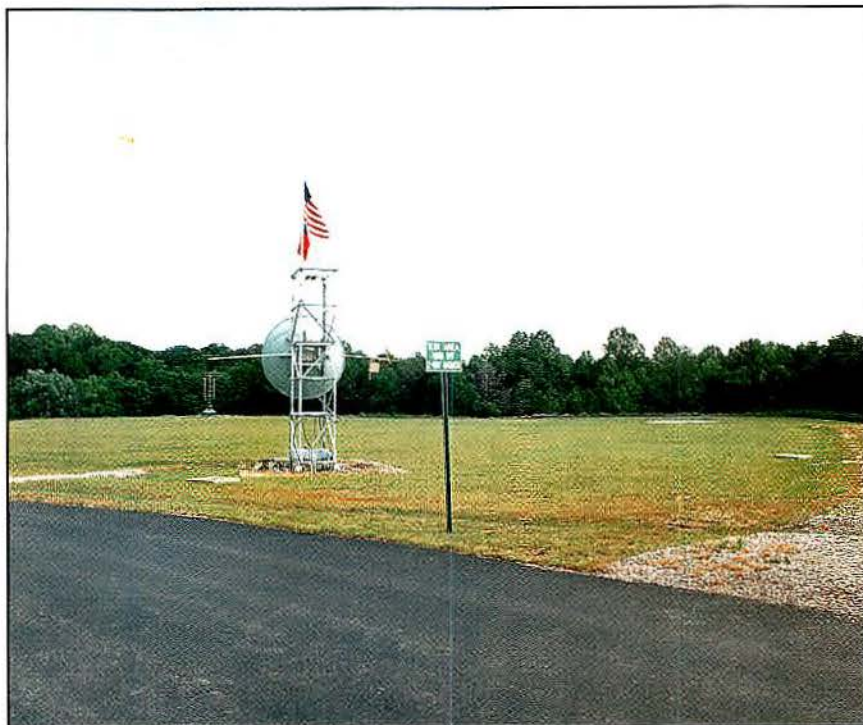
At Unipage, we see a bright future for the paging industry—both for the manufacturers of paging products and the paging service providers. Give us a call, today. We will describe our new products and features that can help brighten your future.



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The area beyond the receive site is kept clear to a distance equal to one-half of the range distance.

The FR959 automated pattern system is the most advanced antenna measurement system available. It allows quick and accurate digital pattern recording.

Figure 6 on page 20 is a diagram of the outside range equipment.

A car rotator is located about 200 feet from the source antenna. This car rotator is used for mobile antenna measurements. A vehicle is rotated a full 360° to measure a complete antenna pattern. This rotator allows rotation about the centerline of any vehicle-mounted antenna.

Measuring an antenna pattern is quite simple with this equipment. The magic is in getting accurate gain numbers—which is the objective.

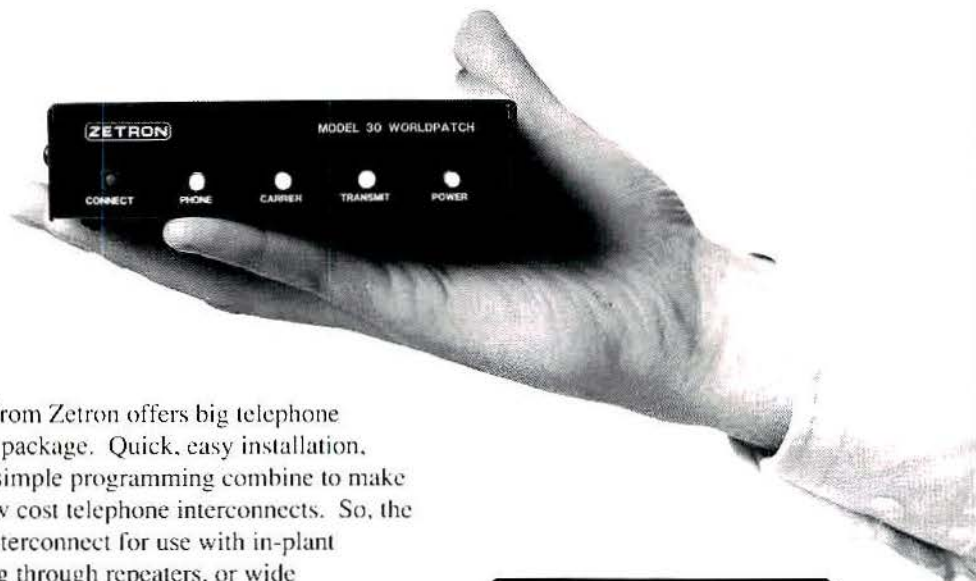
The AUT is mounted on the receive tower and raised into position. Then the source antenna feed polarization is adjusted.

The source antenna is adjusted for maximum signal strength by raising or lowering it.

The 959 controls the entire system. The frequency of interest is entered into

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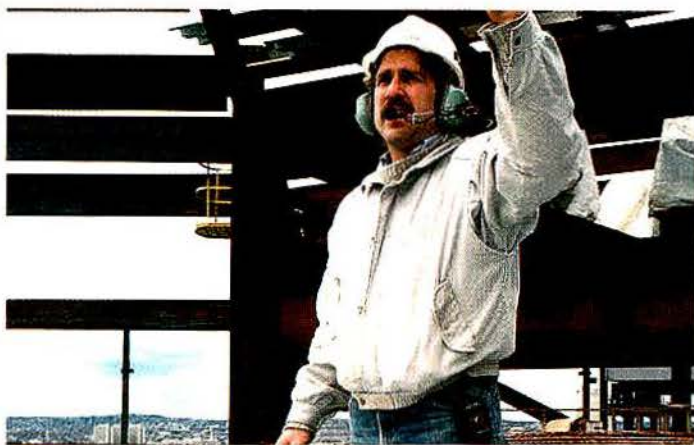
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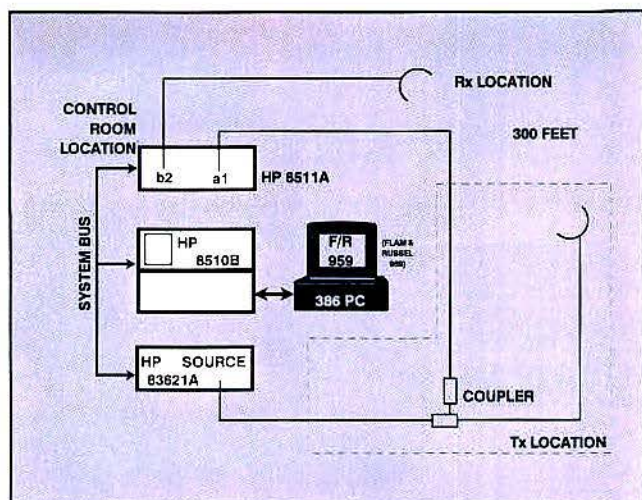


Figure 5. The antenna test range equipment includes an HP83621A, the fastest available sweeper source. The FR959 automated pattern system is the most advanced antenna measurement system available. It allows quick and accurate digital pattern recording.

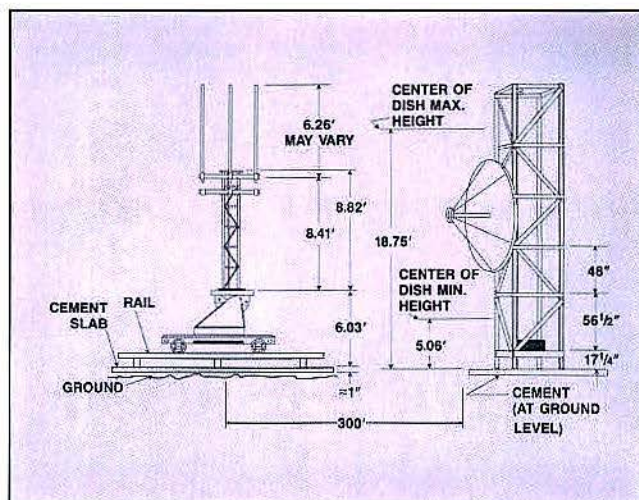


Figure 6. This diagram shows the arrangement of the external equipment on the test range. A car rotator used for mobile antenna measurements is located about 200 feet from the source antenna. A vehicle is rotated a full 360° to measure a complete antenna pattern.

the computer. The computer then controls the HP8510B, which switches on the source as the positioner is rotated through 360°.

As the positioner is rotated, the computer stores the received signal level measurement. The resulting pattern is displayed on a monitor and can be printed or stored for later reference.

To measure antenna gain, a gain standard is substituted for the AUT. Being careful to make sure the transmitted signal level remains constant, the standard

is rotated 360°. This signal is compared with the level measured for the AUT, and the difference is the antenna's gain compared with the standard.

Results measured under ideal range conditions do not necessarily match field results.

For instance, no matter what the front-to-back ratio is of an antenna, the actual front-to-back ratio when the antenna is mounted near large buildings can be considerably less. The buildings in front reflect signal reflected from

structures behind the antenna.

In this situation, reflections limit the front-to-back ratio measured in the field. Reflections from structures, as well as ground reflections and vertical-field distribution profiles, can lead to field performance that differs considerably from range-measured patterns.

Another situation that can arise affects antenna downtilt selection. Although downtilt can be calculated using trigonometry and antenna patterns, optimum downtilt is determined most accurately in the field.

A directional antenna can be adjusted easily with downtilt clamps. Nevertheless, an omnidirectional antenna usually cannot be adjusted for downtilt in the field. One antenna manufacturer offers an omnidirectional antenna with electrical downtilt that can be changed with a mechanical adjustment in the field.

Most land mobile antenna manufacturers offer technical advice to help antenna customers to use antenna patterns and specifications. Together with a little "antenna range magic," knowledge of antenna patterns and specifications can help users to design better performing systems.

Acknowledgements

The author thanks Alex Dolgosh, Dale Horn and Madeline Taylor for their help with this article.

The photographs were taken by Gus Bruno.



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ERMES: The next generation paging code?

High-speed message transmission offers capacity expansion for the paging industry. Although improvements that may speed transmission of POCSAG code are being studied, another European paging code holds promise.

By James W. Marion

The paging market in the United States continues to grow rapidly.

This rapid growth generally can be at-

tributed to the growth in retail pager distribution and new service offerings.

The retail method of pager and pager service distribution makes paging much more visible to consumers who increasingly use paging in their day-to-day lives.

In addition, business use is growing in part because of more advanced services such as radio E-mail (alphanumeric pages to laptop or palmtop com-

puters) and various information services.

Paging market growth requires additional system capacity. Where will the new capacity come from?

Under the auspices of Telocator, the industry is studying this issue carefully. Telocator, a personal communications industry association based in Washington, DC, sponsors several technical committees designed to study, recommend, develop and implement new non-proprietary technology to enhance paging industry growth and to ensure its health.

The committee responsible for improving system capacity via new transmission techniques is the High-Speed Signaling Committee. The committee is studying methods of improving the existing paging code, variously known as POCSAG, RPC1 and CCIR Radio Paging Code #1. In addition, the committee is studying other paging formats, such as the new code format developed for use in the ERMES Pan-European paging system.

What is ERMES?

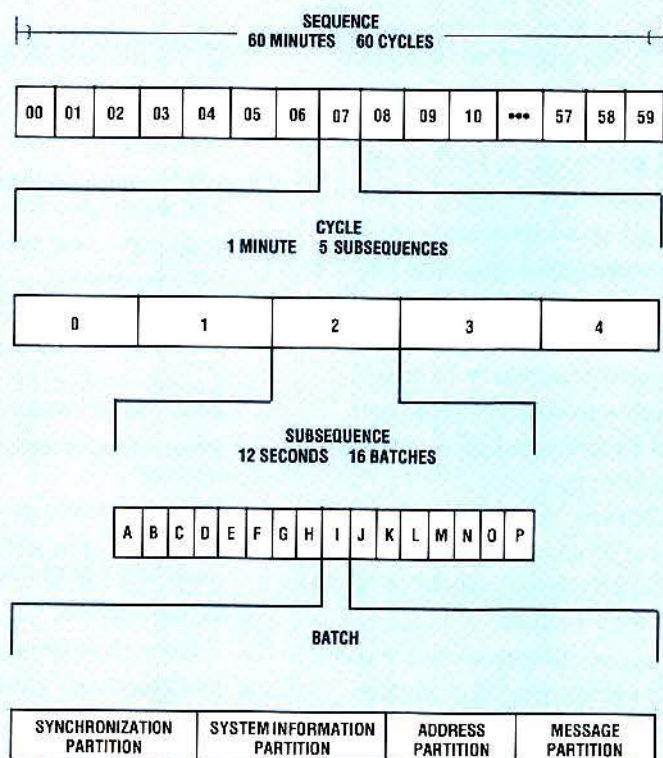
ERMES stands for European Radio Message System.

The name ERMES refers to a system, not merely a new paging code format. The paging code format specified for use in the ERMES system has features that represent improvements over the POCSAG code. (POCSAG stands for Post Office Code Standardisation Group.)

POCSAG code originally was designed to operate at a transmission speed of 512bps.

The POCSAG specification,

Table 1—The ERMES code structure. ERMES pagers 'know' to turn on for one batch every subsequence.



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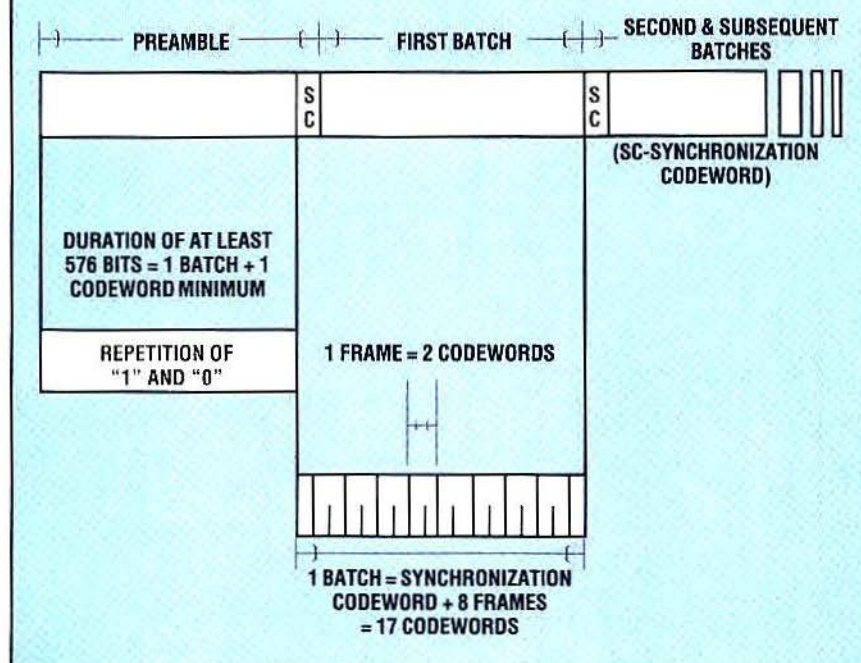
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Table 2—The POCSAG code structure. POCSAG pagers must search for *preamble* in *asynchronous* operation.



nevertheless, does not require transmission at a single baud rate. Because of this fact, 1,200bps was accepted in the U.S. as a de facto standard beginning around 1989. Since then, 1,200bps POCSAG has become the format of choice.

Since fall 1991, 2,400bps POCSAG has been in development by large carriers and manufacturers under the direction of the Telocator committee. The 2,400bps POCSAG will be introduced gradually this year and is expected eventually to supplant 1,200bps POCSAG.

The ERMES format, though, represents a significant increase in transmission speed.

ERMES code operates at 6,250bps, an increase of almost three times the new 2,400bps POCSAG transmission rate. ERMES, therefore, is considered a great leap forward in technology.

Furthermore, the 6,250bps speed is considered to be close to the upper baud rate limit allowable under the current paging system infrastructure, so transmission speed thereby is maximized.

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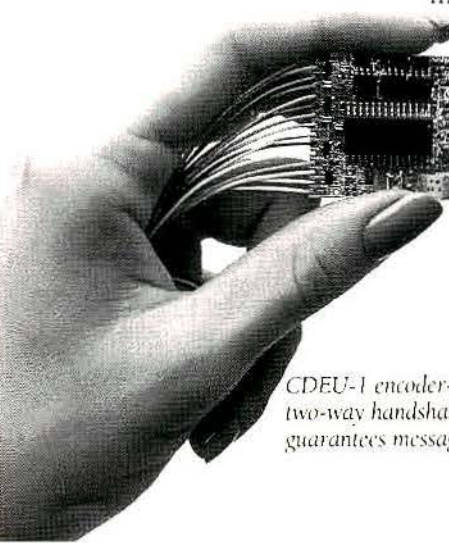
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NINE 4-BIT BLOCKS

0000

0001

0010

0011

0100

0101

0110

0111

1000

STANDARD SERIAL TRANSMISSION:

0000 0001 0010 0011 0100 0101 0110 0111 1000

INTERLEAVED TRANSMISSION:

0000 0000 1000 0111 1000 1100 1100 1010 1010

TRANSMISSION IS BY COLUMNS, NOT ROWS, FOR DISPERSAL OF BIT ERRORS.

Figure 1. The interleaving technique has the effect of spreading out error bits that otherwise occur together.

ERMES uses a synchronous format. POCSAG is asynchronous. (See Table 1 on page 22 and Table 2 on page 24.) This difference has great implications in regard to battery life.

For example, POCSAG pagers, according to the definition of asynchronous operation, never "know" exactly when a page is coming. Therefore, a POCSAG pager must be turning on continuously to detect paging transmissions that may arrive at any time.

ERMES pagers always "know" when to expect a paging transmission by virtue of their synchronous operation. An ERMES pager can turn off and stay off until it is the correct time to turn back on.

In addition to extended off time afforded by the synchronous format, ERMES has built in other battery-saving techniques, such as transmitting pager address codes in descending order. Thus, when a pager receives an address lower in value than its own, it can

turn off immediately instead of waiting until the end of its time segment.

The ERMES battery-saving features alone could make available a pager with a battery life that theoretically could be extended from four to five times that of a POCSAG pager's life. Actual battery life in pagers may never reach this goal because of increased current drain for new features.

Scanning operation

ERMES specifies 16 channels for European operation spanning 169.4125MHz to 169.8125MHz at a channel spacing of 25kHz.

Because ERMES is a European-wide cooperative paging system, ERMES pagers must be inherently capable of operating on any of the 16 channels.

Furthermore, because Pan-European roaming is inherently part of the ERMES format, ERMES pagers must be capable of scanning all 16 channels and receiving pages. This requires a

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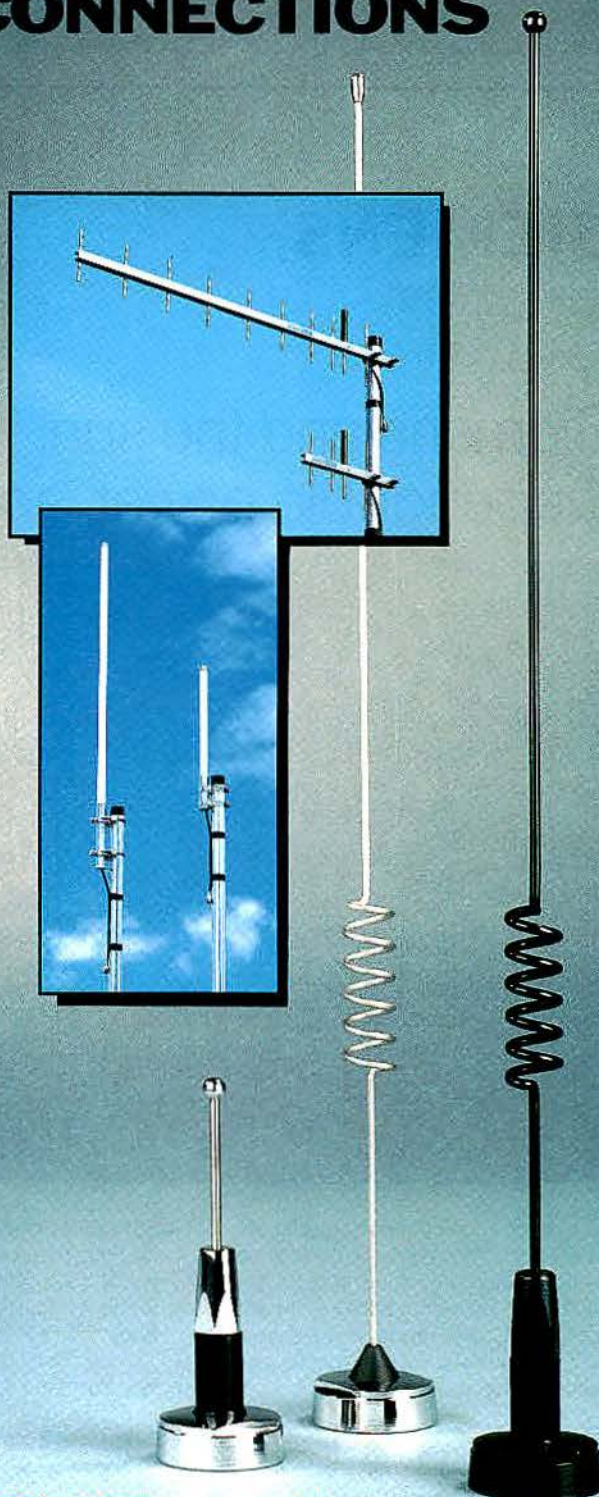
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synthesized, scanning pager, rather than a crystal-controlled pager typical of POCSAG operation.

The scanning feature, although not prohibited in POCSAG, could be useful in cooperative, multichannel networking operations.

Both ERMES and POCSAG are capable of correcting a limited number of bits in each codeword.

This type of error correction works well for random fading; in other words, occasional fading of signal for a brief period that would affect only a single bit at a time. Any burst error (a loss of signal for a period lasting for several bits) would be uncorrectable by POCSAG and would result in a missed page or errors in the message portion of the transmission.

ERMES deals with burst errors by a technique known as interleaving.

Interleaving is handled in ERMES by grouping together nine codewords at a time and stacking them one on top of the other. Then ERMES transmits the nine-codeword block by columns instead of rows.

When a burst occurs, several bits may be affected at one time. However, because codewords are transmitted by columns instead of rows, only a single bit is affected in each codeword.

As previously mentioned, single bits may be corrected using the error-correction bits so that the interleaving technique has the effect of spreading out error bits that otherwise occur together. (See Figure 1 on page 26.)

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Modulation

ERMES specifies 4-PAM/FM modulation. But just what is 4-PAM/FM?

To get a simple overview, it helps to compare the ERMES method with the current POCSAG method.

POCSAG uses 2 level frequency-shift keying (FSK). In this modulation scheme, a binary digit 1 is transmitted when the transmitter shifts its carrier frequency -4.5kHz below the center frequency. A binary digit 0 is transmitted when the carrier shifts $+4.5\text{kHz}$ above the center frequency.

The current POCSAG modulation scheme generally is referred to as 2 level. The new ERMES scheme is generally called 4 level. Carrier shifting is involved in 4 level, but as the name indicates, four frequency-shift levels are used instead of two, and two binary digits or bits are transmitted at each level, according to the following table:

$$\text{Carrier} + 4,687.5\text{Hz} = 10$$

$$\text{Carrier} + 1,562.5\text{Hz} = 11$$

$$\text{Carrier} - 1,562.5\text{Hz} = 01$$

$$\text{Carrier} - 4,687.5\text{Hz} = 00$$

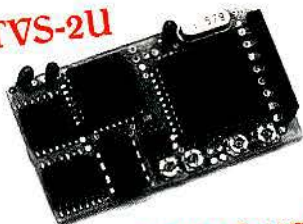
Were it not for the 4 level modulation scheme, the bit rate of 6,250 could not be achieved in the current infrastructure. It is estimated that the maximum bit rate achievable with 2 level FSK is approximately 3,000bps.

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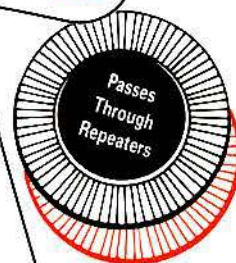
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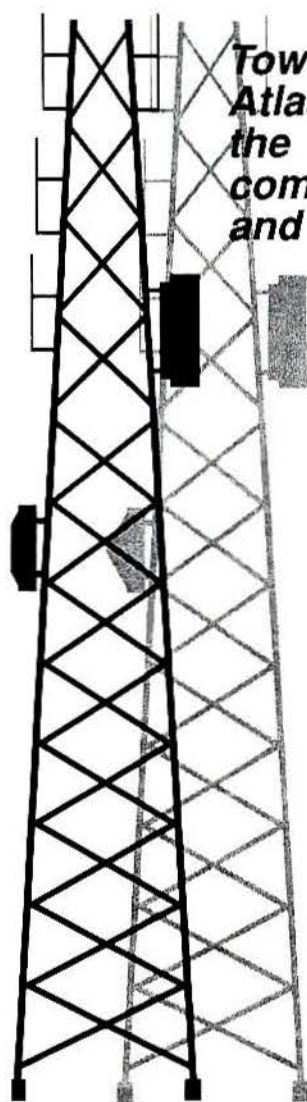
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The primary advantage, then, of 4 level modulation is transmission speed. It comes with some cost because many transmitters are not capable of 4 level modulation without some modification.

The cost of such modification is believed to be minimal when compared to other, more advanced schemes.

ERMES for U.S. operation?

Given the many advantages of the ERMES paging format, it would appear obvious that the ERMES code format would be a natural choice as the next step in paging code format evolution in the United States. Unfortunately, ERMES is not without a few distinct disadvantages that may well prohibit its introduction in the United States.

Capacity increase?

Although the ERMES transmission rate is impressive, the effective bit rate of 6,250bps is not expected to be realized because of the high amount of overhead specified in the format.

Overhead refers to all non-essential information transmitted to the pager. In POCSAG, there is no overhead per se. Nonetheless, some would consider portions of the code, such as the preamble, error-correction bits and synchronization codeword, as non-essential information.

Essential information would be the pager address code and any message codewords that follow.

ERMES, in contrast, has several codewords specifically designed for Pan-European roaming.

These codewords include Country Code, Operator Code, Zone Code, System information and Date and Time Codewords. This type of overhead information is foreign to U.S. pager operations and universally is considered unnecessary. Because the additional bits have no practical use in the United States, they have the effect of reducing the overall transmission speed.

Moreover, the overhead bits are transmitted regardless of the pager message length. Therefore, short numeric messages, which are predominant in the United States, are highly inefficient. Long alphanumeric messages are more efficient, but they are not as efficient as if there were no overhead at all.

The ERMES specification allocates 16 channels in the 169MHz band. These

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frequencies are unavailable for paging service in the United States, so this is one aspect of the ERMES system that cannot be implemented in the United States. ERMES must be used in the United States in frequency bands allocated for paging service. The most likely candidate for ERMES paging is the 900MHz band.

The most pressing need in the United

States is increased capacity on existing systems.

The requirement for roaming on different channels is of minimal importance now. Therefore, the portion of the ERMES specification designed for multichannel scanning must be modified or discarded when U.S. operation is considered.

In addition to simplifying the code,

simpler pager design may be possible because single-channel operation allows the use of a crystal-controlled, non-synthesized pager.

Overspecification

The ERMES specification details all aspects of system operation.

Many portions of system operation should be specified in minimal detail or not specified at all to allow for innovation and multiple vendors. In the highly competitive U.S. environment, the primary item of concern is the *air interface*, that portion of the code in which the paging terminal communicates with the paging receiver.

Telocator common air interface

What will be the next-generation paging code in the United States?

It is clear that ERMES has some distinct advantages. Nevertheless, using the ERMES format as-is never can be a preferred solution to increased capacity demands in today's market. Some minimal modification will be required to address the disadvantages.

What will the new code look like? If ERMES is used as a basis, at a minimum the new format is expected to have some or all of the following characteristics:

- ▶ 6,000+bps transmission rate.
- ▶ synchronous operation.
- ▶ codeword interleaving.
- ▶ 4 level modulation.

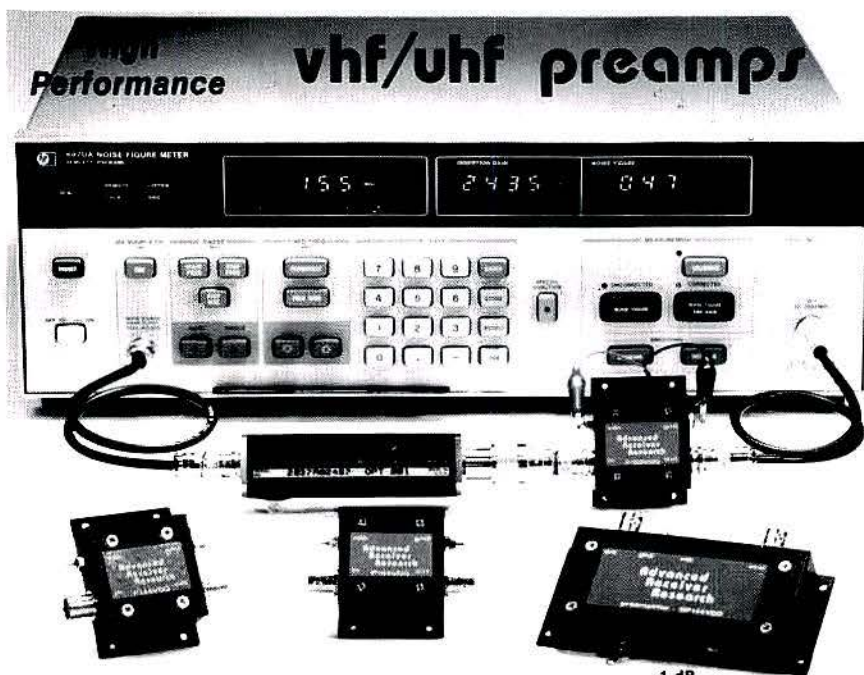
At this point, it is too early to determine what other characteristics may be introduced as the next-generation format gradually is developed.

Is POCSAG completely out of the running? Maybe not.

Some have suggested further increases in the POCSAG bit rate and possible modification of modulation from 2 level to 4 level.

In addition, some alternative schemes have been proposed, such as POCSAG modified for a different frame structure including interleaving.

In any case, the U.S. paging industry now is preparing for future capacity expansion, using the best ideas that Europe and the United States have to offer.



Receive only	Freq. Ranges (MHz)	N.F. (dB)	Gain Comp. (dB)	1 dB (dBm)	Device Type	Price
P30VD, P35VD, P40VD, P45VD	30-35, 35-40, 40-45, 45-50	<1.3	15	0	DGFET	\$ 44.95
P30VDG, P35VDG, P40VDG, P45VDG	30-35, 35-40, 40-45, 45-50	<0.5	26	+12	GaAsFET	\$109.95
P150VD, P160VD, P170VD	150-160, 160-170, 170-180	<1.5	15	0	DGFET	\$ 44.95
P150VDA, P160VDA, P170VDA	150-160, 160-170, 170-180	<1.1	15	0	DGFET	\$ 56.95
P150VDG, P160VDG, P170VDG	150-160, 160-170, 170-180	<0.5	24	+12	GaAsFET	\$109.95
P450VD, P460VD	450-460, 460-470	<1.8	15	-20	Bipolar	\$ 49.95
P450VDA, P460VDA	450-460, 460-470	<1.2	16	-20	Bipolar	\$ 74.95
P450VDG, P460VDG	450-460, 460-470	<0.5	16	+12	GaAsFET	\$109.95
P800VDG, P830VDG, P860VDG	800-830, 830-860, 860-890	<0.6	19	+12	GaAsFET	\$119.95
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SP30VDG, SP35VDG, SP40VDG, SP45VDG	30-35, 35-40, 40-45, 45-50	<0.55	26	+12	GaAsFET	\$139.95
SP150VD, SP160VD, SP170VD	150-160, 160-170, 170-180	<1.6	15	0	DGFET	\$ 74.95
SP150VDA, SP160VDA, SP170VDA	150-160, 160-170, 170-180	<1.2	15	0	DGFET	\$ 88.95
SP150VDG, SP160VDG, SP170VDG	150-160, 160-170, 170-180	<0.55	24	+12	GaAsFET	\$139.95
SP450VD, SP460VD	450-460, 460-470	<1.9	15	-20	Bipolar	\$ 79.95
SP450VDA, SP460VDA	450-460, 460-470	<1.3	16	-20	Bipolar	\$104.95
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Understanding and using field intensity units

Radio communications system designers have to deliver adequate radio coverage to please system owners and end-users. Proper application of field intensity units helps to ensure the desired results.

By Larry D. Ellis, P.E.,
and Michael Wiebe, P.E.

¿Cuál es la fuerza de la señal?

Quam forte est signum?

Wie stark ist das signal?

Quelle force a le signal?

How strong is the signal?

The same thing can be said in several ways, but it only makes sense when you understand the language.

It is confusing when engineers, technicians and equipment salespersons discuss antenna gain and field strength units. People in different radio communications disciplines seem to speak different languages, and most people are not multilingual.

Antenna gain units

Although field strength at any location is independent of antenna gain, received voltage at the receiver input terminals is not.

Gain may be expressed as either a power multiplier or in decibels. Antenna gain in decibels is referenced to either an isotropic radiator or a halfwave dipole.

The microwave industry universally has established the convention of report-

ing antenna gain in dBi (decibels referenced to isotropic).

The land mobile industry almost universally has expressed antenna gain in dBd (decibels referenced to a dipole). When a manufacturer lists gain in dB, you generally may assume the gain is dBd.

Broadcast antenna manufacturers commonly refer to a multiplier gain where the antenna input power is multiplied by gain to yield effective radiated power (ERP).

Isotropic radiator

The simplest antenna is an isotropic radiator, a theoretical antenna that radiates the same energy level in all directions when power is applied.

Even though this antenna cannot actually be constructed, the concept provides a uniform standard against which all manufactured antennas' performance can be calibrated and compared.

A half-wavelength dipole antenna,

which can be built easily, has gain compared to an isotropic radiator. (See Figure 1 below.)

Dipole antenna

The dipole focuses energy in certain directions, so that energy radiated in those directions is greater than energy radiated in the same directions from an isotropic source with the same input power.

A dipole antenna's 2.15dB gain over an isotropic source is expressed by the following equation:

$$\text{dBi} = \text{dBd} + 2.15 \quad (1)$$

Directional antennas, such as the dipole and the antenna represented by Figure 2 on page 36 can be considered to concentrate the available energy fed into the antenna, focusing the energy radiated from the antenna into the desired direction. Energy radiated in the desired direction(s) is increased by reducing the energy radiated in some other direction(s).

For example, a collinear array of four dipole antennas typically has a gain of 6dBd. The same antenna has a gain of 8.15dBi (referenced to isotropic).

Directional antenna patterns sometimes are plotted as gain in decibels above a halfwave dipole. Other patterns are shown as a relative field voltage. These plots are directly transferable as long as the absolute gain in dBd or dBi of the antenna's major lobe is known. The equation is as follows:

$$\begin{aligned} G(\text{dB}) & \\ &= G_m(\text{dBd}) + 20 \log R_v \end{aligned} \quad (2)$$

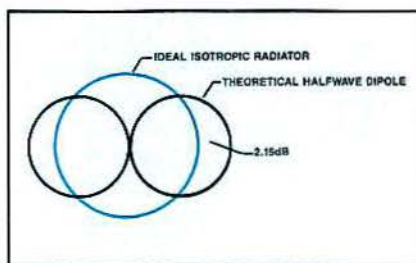


Figure 1. A half-wavelength dipole antenna has 2.15dB gain compared to an isotropic radiator. The dipole focuses energy in certain directions, so that energy radiated in those directions is greater than energy radiated in the same directions from an isotropic source with the same input power.

Ellis and Wiebe own SoftWright, Aurora, CO. This article is adapted from the technical reference chapter "Field Intensity Units" in the company's Terrain Analysis Package (TAP) computer software *User's Manual*.

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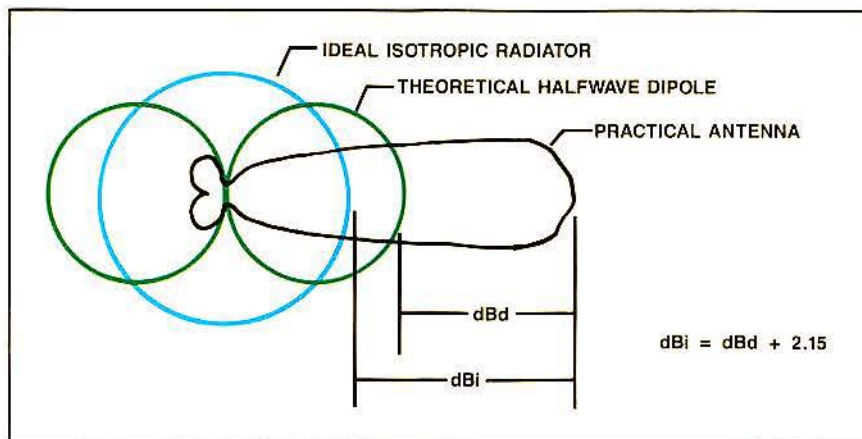


Figure 2. Directional antennas concentrate the available energy fed into the antenna, focusing the energy radiated from the antenna into the desired direction. Energy radiated in the desired direction(s) is increased by reducing the energy radiated in some other direction(s).

where

G = gain in decibels on a particular azimuth

G_m = maximum power gain in decibels referenced to a halfwave dipole

R_v = relative field voltage for the particular azimuth

To convert the gain value in decibels on a particular azimuth to a relative field value, use the following equation:

$$R_v = 10(G - G_m)/20 \quad (3)$$

When the maximum ERP and the relative field voltage on a particular azimuth are known, ERP on that particular azimuth is calculated from the following equation:

$$R_p = P(R_v)^2 \quad (4)$$

where

R_p = ERP on a particular azimuth (in watts, kilowatts, etc.)

P = ERP in the major lobe (maximum) in the horizontal plane (in watts, kilowatts, etc.)

Units of field intensity

There is confusion in the vocabulary for field strength (also called field intensity). Values commonly are expressed in dBu, dBμV and dBm.

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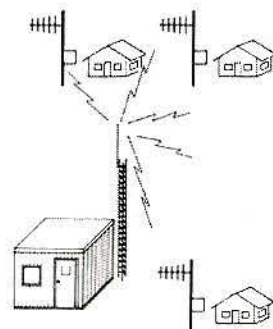
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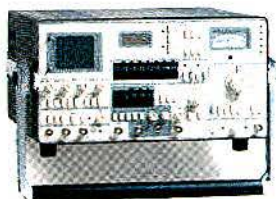
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- Cellular testing



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- Audio synthesizer
- Audio voltmeter



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confusion about how they relate to one another causes frustration and misunderstandings about system design and actual performance.

dBu is E (electric field intensity), always in decibels, referenced to 1 microvolt/meter ($\text{dB}\mu\text{V}/\text{m}$).

$\text{dB}\mu\text{V}$ (using the Greek letter μ [mu] instead of u) is voltage expressed in decibels above 1 microvolt into a specific load impedance. In land mobile and broadcast, this impedance commonly is 50Ω .

dBm is a power level expressed in decibels referenced to 1 milliwatt.

Electric field intensity

The electric field intensity unit dBu is used extensively by the FCC when referring to field strength.

True electric field strength always is expressed in some relative value of volts/meter, never in volts or milliwatts.

Electric field intensity is independent of frequency, receiving antenna gain, receiving antenna impedance and receiving transmission line loss. There-

fore, this measure can be used as an absolute measure for describing service areas and comparing different transmitting facilities independent of the many variables introduced by different receiver configurations.

When a path has an unobstructed line of sight and no obstructions fall within 0.5 of the first Fresnel zone (which would introduce additional attenuation), the received electric field strength approximates that of free space. It may be calculated from the following equation:

$$E(\text{dB}\mu\text{V}/\text{m}) \quad (5)$$

$$= 106.92 + \text{ERP}(\text{dBk}) - 20 \log d(\text{km})$$

where

ERP is expressed in dB above 1kW

d = distance in kilometers

Received voltage and power

Although calculations of electric field

strength are independent of the receiver characteristics mentioned above, predictions of voltage and received power supplied to a receiver input must take each of these factors into account carefully. Correlation between electric field strength and voltage applied to the receiver input is impossible unless all of the information listed above is known and considered in the system design.

When the exact same conditions (path, frequency, ERP, etc.) are applied to identical circumstances, the following equations allow the system designer to translate among the various systems with complete confidence.

Field strength as a function of received voltage, receiving antenna gain and frequency when applied to an antenna whose impedance is 50Ω can be expressed as:

$$E(\text{dB}\mu\text{V}/\text{m}) \quad (6)$$

$$= E(\text{dB}\mu\text{V}) - G_r(\text{dBi}) + 20 \log f(\text{MHz}) - 29.8$$

Solved for received voltage, this equation becomes:

$$E(\text{dB}\mu\text{V}) \quad (7)$$

$$= E(\text{dB}\mu\text{V}/\text{m}) + G_r(\text{dBi}) - 20 \log f(\text{MHz}) + 29.8$$

For power and voltage calculations into a 50Ω load:

$$P(\text{dBm}) = E(\text{dB}\mu\text{V}) - 107 \quad (8)$$

$$P(\text{dBm}) \quad (9)$$

$$= E(\text{dB}\mu\text{V}/\text{m}) + G_r(\text{dBi}) - 20 \log f(\text{MHz}) - 77.2$$

where

G_r = isotropic gain of the receiving antenna

When a "field strength contour" is plotted and identified in dBm or microvolts ($\text{dB}\mu\text{V}$), it is important to know the values of frequency and antenna gain. The user must understand that such "contours" are valid only for one frequency, a specific power loss in the receiving transmission line and the particular receiving antenna gain used

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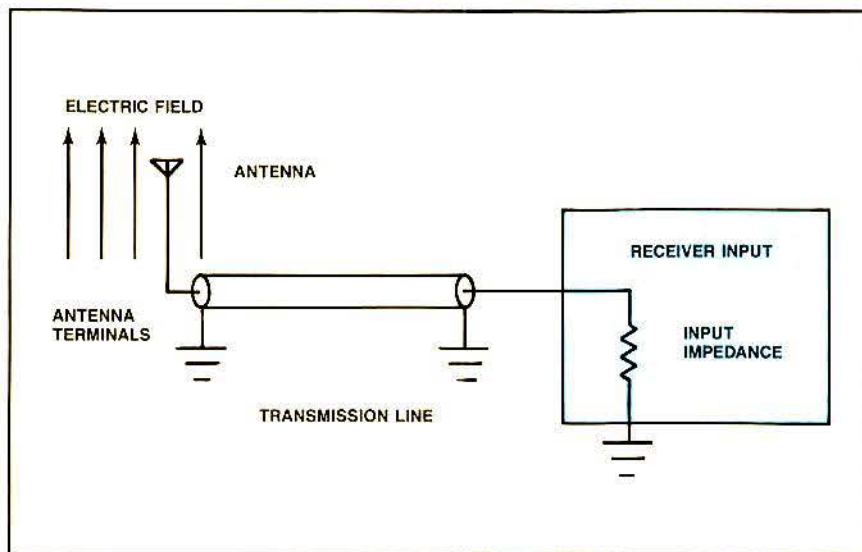


Figure 3. This diagram summarizes the relationship between electric field strength and the voltage and power at the receiver input terminals.

for the prediction.

There is a fixed loss in the receiving antenna transmission line. Although the line often is assumed to be lossless, ordinarily that is not the case.

For these reasons, such "contours" are ambiguous as coverage predictions when all receiving antenna gains and transmission line losses are not identical for all receivers.

To determine the field strength level necessary to receive a transmitted signal adequately use Equation 6 and take into account the frequency, receiving antenna gain and required level of receiver voltage for the desired level of quieting in the receiver.

This equation does not consider important system losses that can account for significant signal reduction:

- ▶ antenna pattern distortion resulting from the antenna mounting.
- ▶ signal attenuation because of the presence of a person's body near a hand-held unit.
- ▶ polarization differences between transmit and receive antenna orientation.

Accurate predictions *must* take these losses into account. These losses often are assumed to be approximately 20dB to 25dB.

The predictions described above are for the voltage at the antenna terminals. Actual voltage and power levels at the receiver input must take into account the additional loss in the receiving transmis-

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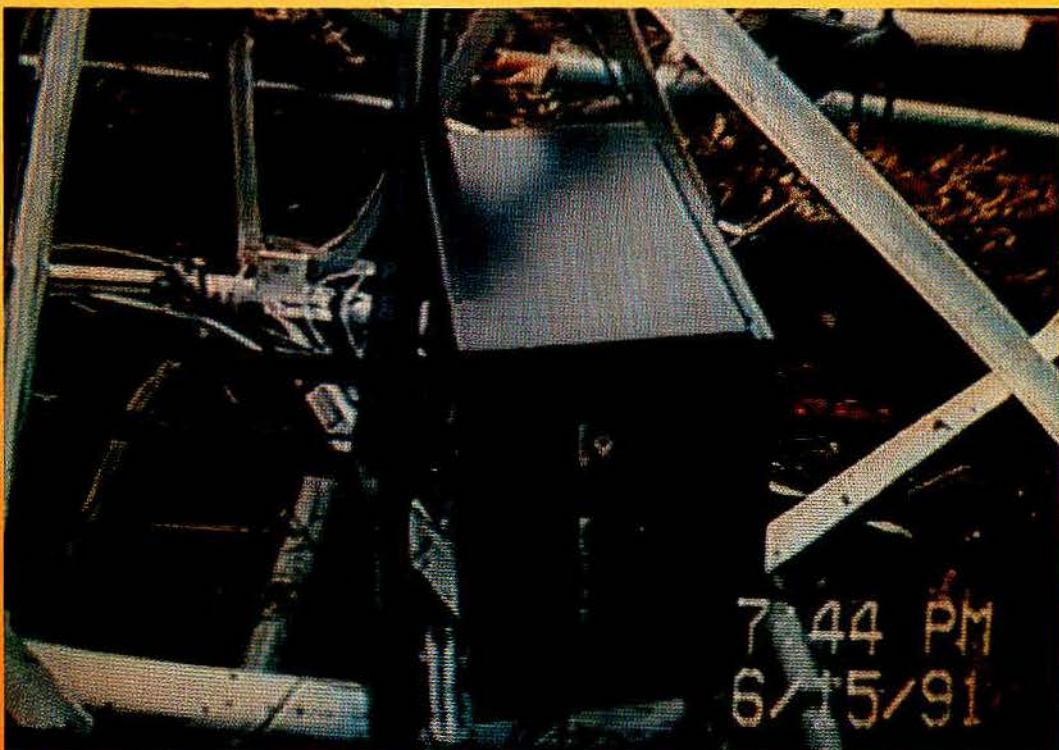


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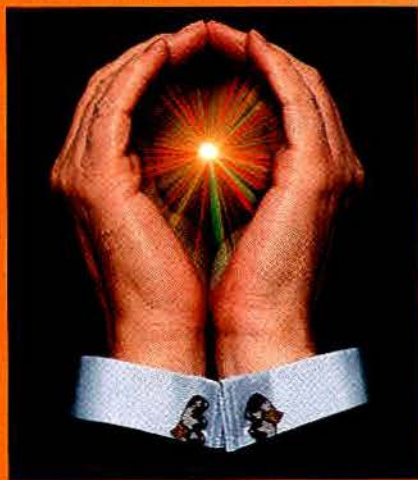
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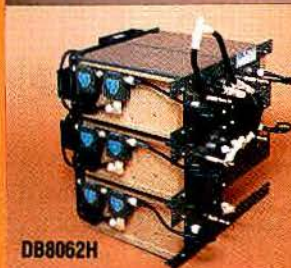


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sion line between the antenna terminals and the receiver input terminals. This signal loss is particularly critical at high frequencies, when transmission lines are long or both.

Figure 3 on page 40 summarizes the relationship between electric field strength and the voltage and power at the receiver input terminals.

The electric field strength (in dBu) is

a function only of:

- ▶ transmitted ERP.
- ▶ distance from the transmitter.
- ▶ losses from terrain and obstructions, and atmospheric conditions.

Because the electric field strength is independent of any receiver equipment characteristics, it is a useful standard for computing coverage areas.

The electric field induces a voltage

into the antenna, transferring power into the antenna. The voltage (dB μ V) at the antenna terminals is a function of the antenna gain for the frequency under consideration. The power (dBm) available at the antenna terminals is a function of the antenna impedance (usually 50 Ω).

The transmission line (usually coaxial cable or waveguide) connects the antenna terminals to the receiver input terminals. The voltage and power at the receiver input terminals are reduced by this transmission line loss. Transmission line losses are a function of the size and type of transmission line and the operating frequency.

Service area predictions are important in designing mobile radio systems and in marketing the services of that system to potential customers. The designer and salesperson must understand the effect that different receiving equipment configurations have on coverage areas.

Receiving systems with different antenna gains require significantly different electric field strength values for proper operation. A service area contour (in dB μ V or dBm) computed for a mobile receiver with a high-gain, permanently mounted roof antenna can be misleading to users with low-gain antennas on hand-held units.

Based on the actual equipment proposed and the preceding equations, the system designer can calculate the actual field strength necessary for any particular receiving system. Operating the receivers in areas where the field strength meets or exceeds the design level for the equipment can be expected to produce satisfactory system performance.

Reference material

1. Adams, Jean, *Telecommunications Analysis Services User's Reference Guide*, Appendix A, U.S. Department of Commerce, Boulder, CO, telephone 303-497-5301.
2. Catalog No. 21, Decibel Products, Dallas, telephone 214-631-0310.
3. Kraus, John D., *Electromagnetics*, Fourth Edition 1992, Book number 007-035-621-1, McGraw-Hill Book Company, New York, telephone 800-233-1128.
4. Wiebe, Michael, P.E., and Larry D. Ellis, P.E., "Use Digitized Terrain Data To Plan a Repeater Site," *Mobile Radio Technology*, August 1989.



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Output voltage:	115 VAC RMS \pm 5%	115 VAC RMS \pm 5%	115 VAC RMS \pm 5%
Output frequency:	60 Hz \pm 2%	60 Hz \pm 0.01%	60 Hz \pm 0.01%
Output waveform:	modified sinewave, phase corrected	modified sinewave, phase corrected	modified sinewave, phase corrected
Efficiency:	90%	90%	90%
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Mobile Communications Marketplace pre-show overview

The latest innovations in the cellular, paging and Personal Communications Service (PCS) industries will be featured at the Mobile Communications Marketplace in San Francisco's Moscone Convention Center. More than 150 exhibitors will display their products and services during this Telocator-sponsored event Sept. 23-25.

Two simultaneous pre-convention seminars will lead off the educational side of the conference on Tuesday, Sept. 22, at the Moscone Convention Center. "Interconnecting America's Electronic Superhighway," sponsored by Telocator and *Mobile Radio Technology*, will focus on efforts to implement new interconnection arrangements that will benefit customers of both the landline and wireless networks; the economic impact of new network capabilities and how they boost service revenues; new plans to resolve number scarcity; and whether regulatory changes are keeping pace with today's new interconnection requirements.

"Mobile Data: Revolutionizing the Way Information Is Delivered" will cover the new opportunities created by transmitting data over wireless networks. Existing cellular and paging networks; packet networks such as Ardis and RAM; and the challenges in providing data service that meet strict customer demands will be explained.

Roundtable discussions, Early Bird sessions and panels begin Thursday,

Event: Mobile Communications Marketplace

Dates: Sept. 23-25

Location: Moscone Convention Center

City: San Francisco

Number of Exhibitors: 150

Exhibit Hours: Wednesday, Sept. 23--noon to 5 p.m.

Thursday, Sept. 24--noon to 6 p.m.

Friday, Sept. 25--9 a.m. to noon

Seminar Schedule: Tuesday, Sept. 22--8 a.m. to 5 p.m.

Wednesday, Sept. 23--8 a.m. to noon

Thursday, Sept. 24--8 a.m. to noon

Friday, Sept. 25--8 a.m. to noon

Registration/Hotel Information: 202-467-4770

Sept. 24, and continue until noon on Friday, Sept. 25. About 30 sessions on subjects including mobile satellite services; sales and marketing; licensing; credit and collections; and PCS standards are scheduled. As many as 150 speakers will share their knowledge and experience during the educational sessions.

Sam Ginn, president of Pacific Telesis Group, will deliver the keynote address during the convention's opening session. Pacific Telesis is a leader in cellular and paging and has entered the fields of PCS experimentation, wireless data and vehicle location.

Following Ginn's address there will be a special session titled "Wireless 2000." The session will feature a panel of industry experts discussing the technologies that will define a new genera-

tion of mobile services.

FCC commissioner Sherrie Marshall will address participants at the convention's concluding luncheon on Friday from 12:15 to 2 p.m.

Marshall was appointed to the commission in 1989, after serving in both the Reagan and Bush administrations, as director of the FCC's Office of Legislative Affairs and as principal coordinating officer for the U.S. Treasury Department.

For a complete rundown on sessions, dates and times, refer to the "Sessions" guide on pages 46 and 48.

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Mobile Communications Marketplace

Sessions

DAY	TIME	TOPIC
Tuesday, Sept. 22	Pre-convention seminars	
	<i>Seminar I: Interconnecting America's Electronic Superhighway</i>	
	8:30 a.m.	Interconnecting America's Electronic Superhighway
	9 a.m.	Where the Network Is Going--and What it Means for the Wireless Industry
	10:45 a.m.	Looking Ahead: The Economic Impact of New Network Capabilities
	12:15 p.m.	Keynote Luncheon
	2 p.m.	The Numbering Maze
	3:45 p.m.	The Regulatory Agenda
	<i>Seminar II: Mobile Data: Revolutionizing the Way Information Is Delivered</i>	
	9 a.m.	Welcome
	9:15 a.m.	Overview <ul style="list-style-type: none"> ◆ What the User Wants ◆ Merging the Computer Industry with Mobile Communications
	9:15 a.m.	A Look at Today's Networks <ul style="list-style-type: none"> ◆ Cellular ◆ Paging ◆ Packet-Switched Networks
	12:15 p.m.	Keynote Luncheon
	2 p.m.	The Regulatory Climate: Is More Spectrum Necessary? Is It Likely To Become Available?
	3:30 p.m.	Are Current Networks Up to the Challenge?
Wednesday, Sept. 23	9-10:30 a.m.	State of the Association Address Keynote Address
	10:45 a.m.	Special Session Wireless 2000--The Future of the Industry
Thursday, Sept. 24 (continued on page 48)	8 a.m.	Mobile Satellite Services
		Alpha Paging with Voice and Fax Mail Applications
		Tax Issues in the '90s
		Psychographics: Why Do People Buy?
		Prospering as a Conventional Mobile Telephone Service Provider

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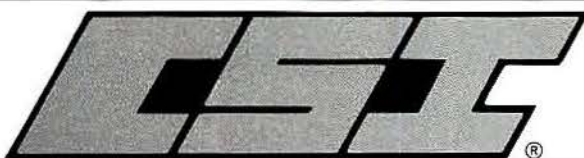
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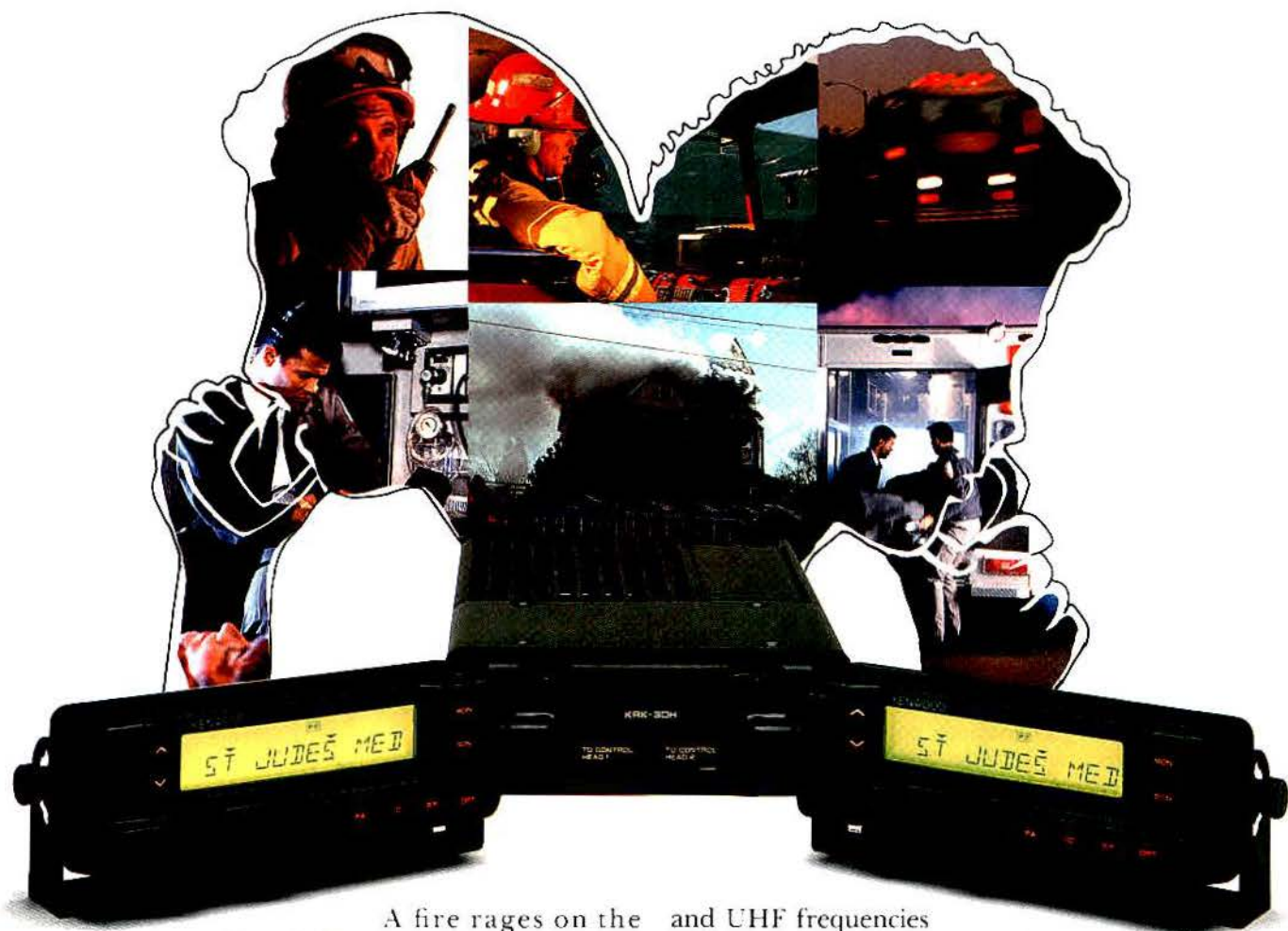
Mobile Communications Marketplace

Sessions

DAY	TIME	TOPIC
Thursday, Sept. 24 (continued)	9- 10:30 a.m.	PCS: Trial Results
		Financing Strategies for Under \$10 Million
		PCP Regulatory Development: The Stakes Go Higher for Private Paging
		Secrets of Great Marketing
		Paging to Computer Links: An Update
	10:45 a.m.	PCS Standards
		Advanced Messaging: Responses to Telocator's AMS Petition
		Going for Big Bucks: Maximizing Your Capital
		Forfeitures, Amnesty and Deregulation: The Rewrite of Forfeiture Policies
		Moving From Customer Service to Customer Care
Friday, Sept. 25	8 a.m.	North American Numbering Plan
		Licensing Workshop
		Credit and Collections
		Start-Up Blues
		Finance Roundtables
		Sales & Marketing Roundtables
		Technical Roundtables
	9- 10:30 a.m.	PCS: Sharing with Microwave Users
		Mobile Communications Investment Climate
		Issues and Answers--A Dialogue with FCC Officials
		Marketing Paging to the Consumer Marketplace
		Satellite Systems--Backhaul and Satellite Broadcast
	10:45- noon	SMR vs. Cellular: Who Will Win the War?
		Promotion in the '90s
		RF Propagation in the Microcell Environment
	12:15- 2 p.m.	Luncheon with FCC Commissioner Sherrie Marshall



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IMCE/Fall pre-show overview

International Mobile Communications Expo/Fall at the Georgia World Congress Center in Atlanta, Sept. 1-3, will include three days of technology-oriented exhibits and seminars.

Last year's show drew 4,500 participants--including 1,500 exhibiting personnel representing more than 200 exhibiting companies. At least that many are expected this year.



End-users represented at the show will include public safety agencies, transportation companies, petroleum producers, public utili-

ties, government agencies and other business and industrial companies. Other participants at the show will be two-way radio dealers and service shops; SMRs; cellular operators and dealers; RCCs and PCPs; exporters and importers; consultants; manufacturers; and representatives.

Leading marketing and engineering personnel will be available to talk with participants about the products and services they have on display:

- ✓ mobile data
- ✓ mobile and portable radios
- ✓ cellular systems and services
- ✓ paging equipment
- ✓ mobile satellite
- ✓ antennas and related accessories
- ✓ test equipment

- ✓ auxiliary equipment
- ✓ tone signaling and control equipment
- ✓ towers

The seminars are divided into Industry, Mobile Communications, Cellular and Latin American tracks, with some of the Latin American sessions being conducted entirely in Spanish.

General topics for the sessions include site management, mobile data systems, PCS, the future of cellular, the FCC and wireless communications.

User panels are scheduled, dealing with such topics as spectrum cost and land mobile radio.

Because of the growing link between mobile communications and satellites, the Satellite Fundamentals Program is an increasingly

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Dates: Sept. 1-3

Location: Georgia World Congress Center

City: Atlanta

Number of Exhibitors: 200

Projected Attendance: 4,500

Exhibit Hours: Tuesday, Sept. 1--11 a.m.-6 p.m.

Wednesday, Sept. 2--11 a.m.-5 p.m.

Thursday, Sept. 3--10 a.m.-1 p.m.

Seminar Schedule: Tuesday, Sept. 1--9 -10:45 p.m.

1 -3:45 p.m.

Wednesday, Sept. 2--9-11:45 a.m.

2-4:45 p.m.

Thursday, Sept. 3--9-11:45 a.m.

Registration/Hotel Information: 303-220-0600

popular event. Participants must be preregistered, and they can sign up to attend one or both of the three-hour sessions. The registration fee includes a three-day exhibits-only pass. Classes include both non-technical and technical satellite fundamentals for mobile communications professionals.

Several special events are planned throughout the three-day event. The grand opening ceremony is Tuesday, Sept. 1, at 10:45 a.m. at the Georgia World Congress Center exhibit hall. An opening-day buffet luncheon is scheduled Tuesday from noon until 2 p.m. The luncheon is open to show participants with full registrations.

A second-day cocktail party for participants and exhibitors is scheduled for Wednesday, Sept. 2, from 3-5 p.m. in the exhibit hall of the Georgia World Congress Center. A Latin American reception is planned for Wednesday evening.



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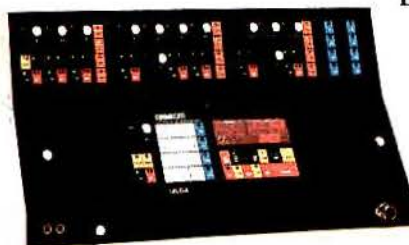
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Choosing design options for bus communications

Careful analysis of radio channel requirements to support bus milestone and status reporting communications systems rules out impractical alternatives. Conventional radio channels offer the most advantages.

By Herb Sachs

"Why do you want to put mobile radios in your transit system or school buses?"

The routine answer is to report unusual occurrences and to provide a safety link for the driver and passengers.

Often, the impetus for installing a radio system is a hijacking, a passenger's heart attack or another life-threatening event.

Sometimes transit managers cite the ability to report a disabled bus or a student who failed to appear for a scheduled pickup.

The needs are real, but the messages are infrequent. Days, if not weeks, may pass without such calls from most buses. Without an unusual event and if the driver reasonably maintains the route schedule, there is no need for a radio call.

Sachs is a communications consultant in Bowie, MD. He is a member of *MRT's* editorial advisory board.

This level of message traffic can be met easily with a small number of conventional radio channels. Even a 1,000-bus system probably can be managed with two voice channels and one or two control center operating positions.

Using digital transmitter identification when the radio is keyed and digital emergency signaling for single-button emergency message transmission does not change the channel requirements.

Milestone reporting by voice

Some bus companies need to track arrivals and departures from particular mileposts, such as garages, bus stops and key intersections to verify route schedules.

The most direct way is for drivers to radio the information: "This is the Route 379 bus, I have just left Pleasantville School with 38 pickups," for example, or "Bus No. 720 has just arrived at Main and Sixth."

Under these conditions, message traffic is sensitive to the number of buses,

the number of mileposts, milepost spacing and bus speed between mileposts. Messages must be transmitted often enough to be useful in controlling the bus schedule.

Table 1 on page 56 indicates typical channel requirements for voice milestone reporting.

Two message reliability criteria are used because both frequently are used in evaluating voice radio system performance. Conventional voice systems generally are analyzed on the basis of waiting time. On the other hand, the measure for trunked systems usually is the percentage of busy conditions encountered.

The busy condition values in Table 1 come directly from blocking probability tables. Waiting times come from queuing equations.

As voice message traffic increases, the number of conventionally configured channels becomes prohibitive. The improved efficiency offered by trunking channels is evident, although this improvement is deceptive.

For example, an evaluation of a system with 400 school buses showed that a six-message-per-hour rate seems consistent with route operation report requirements. Table 1 shows that this level of traffic requires from eight to 12 trunked channels, depending on message reliability requirements.

These numbers are well above the FCC conditions for licensing trunked radio systems (70 to 100 mobiles per authorized channel), and it is unlikely that more than five or six trunked channels could be obtained for the system.

Thus, except in special, low message-

Principles

- ☐ Trunking is not appropriate for bus voice communications systems.
- ☐ Trunking of bus data communications (status messages) is not a viable system design option.
- ☐ Bus data communications can be handled best over dedicated radio channels. Sending data over the trunked voice system control channels sometimes may work, but if there is no need to trunk voice in the first place (and there does not appear to be), then use of dedicated data channels is the only option.
- ☐ Data communications for bus properties have narrow applications and usefulness, and then only if the transit system is prepared for large investments in fixed-end hardware and employees.

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Table 1—Summary of message traffic and loading based on 10-second voice messages.

NO. OF MESSAGES PER BUS PER HOUR	NO. OF BUSES	CONVENTIONAL CHANNELS		TRUNKED CHANNELS#		CONVENTIONAL CHANNELS		TRUNKED CHANNELS#	
		5% BUSIES	10% BUSIES	5% BUSIES	10% BUSIES	2 SEC DELAY	5 SEC DELAY	2 SEC DELAY	5 SEC DELAY
1	400	23	12	4	4	7	4	3	2
1	1,000	*	28	7	6	17	9	5	4
2	400	45	23	6	5	14	7	4	4
2	1,000	*	*	11	10	34	17	8	7
6	400	*	*	12**	11**	40	20	9**	8**
6	1,000	*	*	25**	23**	*	50	19**	18**

One additional channel needed for system control

* Greater than 50

** The FCC probably would not license this quantity of trunked channels for this system.

Number of buses in operation: 400 or 1,000.

Number of voice messages per bus per hour: 1, 2 or 6.

Message reliability desired: 5% or 10% channel busy condition, or limit of 2-second or 5-second mean delay to access a channel.

Type of channel configuration desired: conventional or trunked.

Average message length: 10 seconds.

traffic situations, the concept of voice milestone reporting cannot be supported with either conventional or trunked radio channels.

Digital milestone reporting

The alternative to reporting arrivals

and departures by voice is to report them digitally. Hardware is available to send messages by push-button operation. This method simplifies reporting, puts the burden of channel access on the radio instead of the driver and allows far greater channel throughput because dig-

ital messages are shorter than voice messages.

For example, a driver pushes one button upon leaving the garage, another button upon reaching Main and Sixth and another upon leaving the bus. Channel access is handled automatically; messages are held and transmitted when a channel is available.

In a typical digital status system, when a status button is pressed, the mobile unit checks the downlink for an inhibit message. If it receives an inhibit message, the talk-in frequency is in use and the mobile unit waits.

When the inhibit message disappears, mobile units waiting with messages contend for the channel based on a random timing scheme. The first mobile to acquire the channel causes the system to initiate an inhibit message, and the remaining mobiles wait. This process repeats until all mobiles with messages are served.

► *Dedicated channels*—The number of dedicated conventional channels needed to handle specific volumes of

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Table 2—Summary of message traffic and loading on dedicated conventional channels for digital status messages, assuming a desired message reliability of 90% and a maximum tolerable message delay time of 10 seconds.

NO. OF MESSAGES PER BUS PER HOUR	NO. OF BUSES	NO. OF CHANNELS NEEDED STATUS MESSAGE LENGTH (sec)			
		2	1	0.5	0.25
6	400	3	1	1	1
6	1,000	6	2	1	1
10	400	4	2	1	1
10	1,000	9	4	2	2
15	400	6	2	1	1
10	1,500	14	5	3	2

Number of buses in operation: 400, 1,000 or 1,500.
Number of voice messages per bus hour: 6, 10, or 15.
Message reliability desired: 90%.
Maximum tolerable message delay time: 10 seconds.
Average message length: 2, 1, 0.5, or 0.25 seconds.

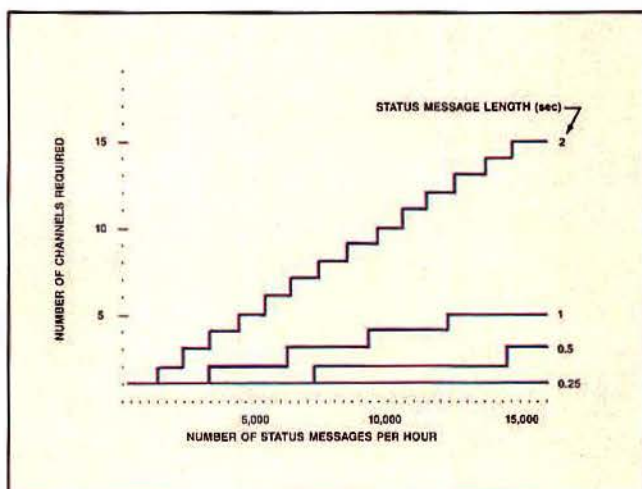


Figure 1. Channel requirements for digital status messages on dedicated channels.

Table 3—Summary of message traffic and loading on a trunked system for digital status messages.

PART A, NO. OF CONTROL CHANNELS NEEDED				
NO. OF MESSAGES PER HOUR PER BUS	NO. OF BUSES	TRUNKING MANAGEMENT LOAD		
		5%	20%	
6	400	1	1	
6	1,000	1	1	
10	400	1	1	
10	1,000	2	2	
15	400	1	2	
10	1,500	3	3	

PART B, NO. OF TRUNKED CHANNELS NEEDED					
NO. OF MESSAGES PER HOUR PER BUS	NO. OF BUSES	STATUS MESSAGE LENGTH (sec)			
		2	1	0.5	0.25
6	400	2	1	1	1
6	1,000	4	2	1	1
10	400	3	2	1	1
10	1,000	6	3	2	1
15	400	4	2	1	1
10	1,500	9	5	3	2

PART C, TOTAL NO. OF CHANNELS NEEDED										
NO. OF MESSAGES PER BUS PER HOUR	NO. OF BUSES	STATUS MESSAGE LENGTH IN SECONDS AND TRUNKING MANAGEMENT LOAD								
		2		1		0.5		0.25		
		5%	20%	5%	20%	5%	20%	5%	20%	
6	400	3	3	@	@	@	@	@	@	
6	1,000	5	#	3	#	@	#	@	#	
10	400	4	4	3	3	@	@	@	@	
10	1,000	#	#	#	#	#	#	#	#	
15	400	5	#	3	#	@	#	@	#	
10	1,500	#	#	#	#	#	#	#	#	

@ One control channel feeding one trunked channel—not a viable trunked system
Requires more than one control channel

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status messages, as functions of desired message reliability, message length and tolerable message delay time, has been calculated.

Table 2 on the top left lists these channel requirements for specific values of the variables involved. Figure 1 on the left summarizes some of the results in a graph.

Figure 1 shows that channel loading is a strong function of message length. As message lengths decrease from two seconds to 0.25 second, channel requirements for a heavily loaded system (15,000 messages per hour) drop from 14 channels to two channels. This span of message lengths covers the capabilities of past and currently available status and message systems.

► **Trunked channels**—A second alternative in handling bus status messages is to trunk the information.

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Trunking involves the bus status unit calling in on a control channel and automatically being assigned another channel to transmit its digital message.

Because no justification has been made for trunked voice messages, it is assumed that the trunking system will be used only for handling status messages. It is assumed that requests for channel assignments are queued, just as

they would be for voice trunking.

Two additional effects not dealt with when putting data messages on conventional channels must be considered for message trunking:

(1) Two time periods must be recognized. One corresponds to the response time associated with the receipt of the channel request message. The other is the interval between the receipt of the

channel request message and the time the message itself is assigned to a trunked channel.

For the first period, a maximum tolerable time of 10 seconds is assigned. The additional time for the channel assignment queue differs for each situation and typically is less than one second.

(2) Unlike the use of conventional channels, message trunking includes contention with other status messages and with message traffic used to manage the trunking system itself.

To deal with the contention issue, two values of control channel loading by the trunking system itself have been assumed: 5% and 20%. These values are intended to bracket the range of loading values that actually exist in commercial trunking systems.

As trunking system loading increases, status message traffic reduces correspondingly. Nonetheless, at the assumed loading levels, little reduction occurs.

The analysis assumes that trunking system internal messages and channel request messages are about the same length: 0.5 second.

Table 3 on page 58 summarizes the results of calculation of channel loading because of trunked status messages. Loading on the control channel is not a function of message length because requests to assign a channel are not dependent on message length.

Table 3 shows that trunking status messages offers no real advantage compared to using dedicated conventional channels.

In addition, some calculated trunking situations are entirely impractical and thus must be eliminated from consideration. Examples include a system using one control channel to feed one trunked channel and a system needing more than one control channel (a condition incompatible with most trunking designs).

Control channel status

The last alternative for handling digital status messages is to transmit the status messages over a trunked voice radio system control channel.

Many installed trunked systems operate in this way. This option does not have to transfer messages to trunked channels, but it must deal with the competitive loading from trunking system

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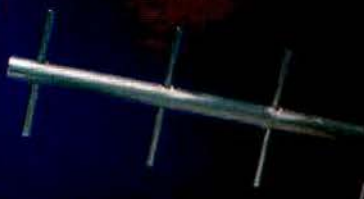
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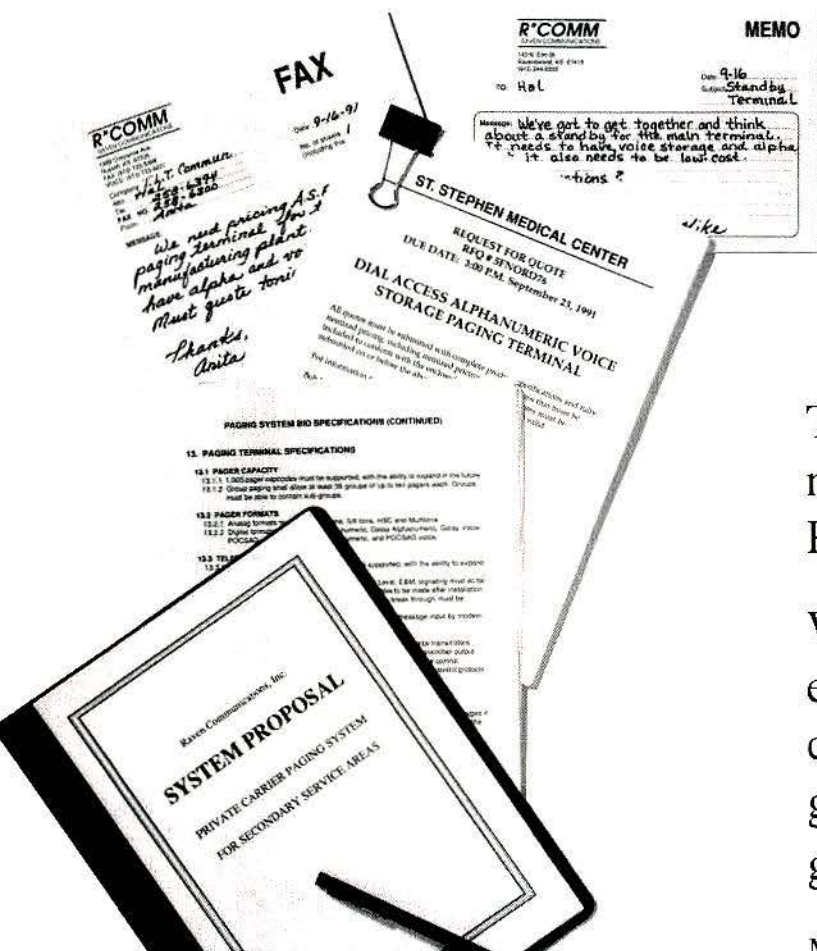


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Table 4—Summary of message traffic and loading on the control channel of a trunked system for digital status messages, assuming a desired message reliability of 90% and a maximum tolerable message delay time of 10 seconds.

		NO. OF CHANNELS NEEDED FOR STATUS MESSAGE LENGTH IN SECONDS AND TRUNKING MANAGEMENT LOAD							
NO. OF MESSAGES PER BUS PER HOUR	NO. OF BUSES	2		1		0.5		0.25	
		5%	20%	5%	20%	5%	20%	5%	20%
6	400	3	4	1	2	1	1	1	1
6	1,000	7	8	3	3	1	2	1	1
10	400	5	6	2	2	1	1	1	1
10	1,000	11	14	4	5	2	2	1	1
15	400	7	8	3	3	1	2	1	1
10	1,500	16	20	6	7	3	3	2	2

management messages. Table 4 above lists the results of this analysis.

This alternative generally is not an option for bus radio systems. After all, they do not require voice trunking in the first place. Information about this alternative is included only for the reader in-

terested in its capabilities in a voice trunking environment.

An interesting system design possibility does arise. Bus digital status messages could use the control channel of a non-bus voice trunking system, such as a local government network, and

share voice channels with that activity. Careful consideration of such a possible sharing arrangement would be necessary to ensure the two sets of users are compatible.

Results

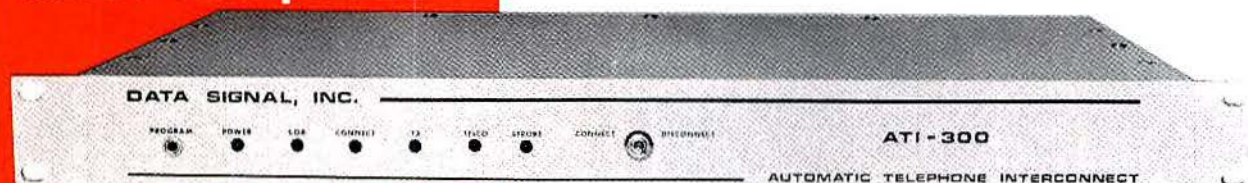
Individuals who must consider alternative status system designs should note that particular values for variables were picked for the analysis. The tables should be recalculated using values that represent actual communications needs and actual hardware available to you.

► *Voice status*—This approach has a role only when status message loading is extremely light. Otherwise, it quickly can impose large channel requirements. Based on the perceived needs of a bus status system, this approach works only for exceptionally small systems.

► *Digital status, dedicated channels*—This option is the best and virtually only choice for handling status messages for all levels of message length and loading. It becomes highly efficient as status message lengths be-

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come especially short.

► **Digital status, trunked control channels**—This option is almost as good as using dedicated channels, but it is not ordinarily an alternative for bus systems.

The need to use more than one control channel generally is incompatible with trunked system design. A high level of trunking system management messages further reduces this alternative's

potential.

► **Digital status, trunked**—For cases that can be implemented, generally there is no advantage to trunking status messages on an all-data trunked system.

Depending on the required message rates and other factors, some requirements cannot be configured for trunking. High message rates could dictate the need for more than one control

channel. Low message rates could reduce the system configuration to an unreasonable arrangement of one control channel and one message channel.

Commentary

One reason trunking is an efficient voice radio system design is the time it takes to assign a user a channel is short compared to the message length. This is not the case with trunked status messages. In fact, in most cases, the reverse would be true. As a result, the benefits of reduced load with trunking disappear.

Even if a voice trunking system were available and if superimposing data trunking had loading advantages, the configuration is not advisable.

It is risky to have data messages compete with voice messages on such a system. When all channels are in use by voice messages, it could be a relatively long time before any data messages would be allowed into the system.

Fleet owners and managers must have strong needs for using digital data to control bus scheduling. Data rates for even modest bus properties will be much higher than a reasonable number of human operators can process, so computerized bus schedules and software to compare incoming messages against the schedules are needed.

Supplemental hardware in each vehicle is necessary. Site controllers, message switches and multiple console positions at the fixed end must be added and—perhaps most significantly from the investment aspect—more operational staff are necessary.

Any system that employs manual initiation of status data must face the possibility that buttons will intentionally or accidentally be pushed too early, too late or not at all. Incorrect buttons may be pushed. A labor union may view status reporting as an undesirable intrusion on member rights.

These possibilities must be considered when deciding whether a bus milestone and status reporting system is a practical communications addition.



This article, which was sent to *MRT* in March 1991, summarizes a longer paper containing technical details of the analysis. For a copy of the original paper, send a request to the author at P.O. Box 729, Bowie, MD 20718.

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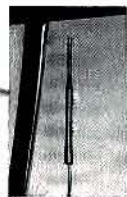
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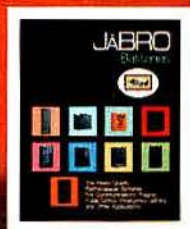
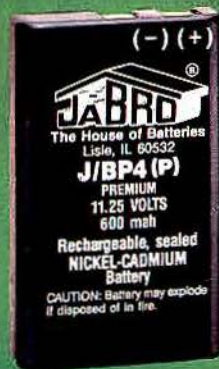
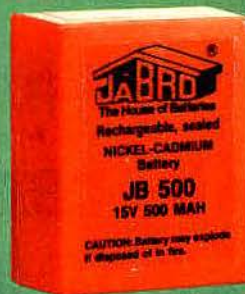
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The easy way to align mobile radio, telco levels

Keeping voice levels equal for mobile radio and telephone equipment can be challenging. Using -6dBm0 as a telephone circuit reference level helps to resolve complaints about too much or too little volume and distortion.

By Earl M. Tice

What do you do when you continue to receive complaints about low levels ("I can't hear."), high levels ("It's too loud.") or distortion ("It doesn't sound clear.") after you have set all voice level adjustments according to a routine?

Do you tell the users they do not know what they are talking about? Or do you

re-adjust an amplifier here and there until the users say: "It's OK now!"?

Maybe your voice level alignment procedure should be improved. Incidentally, is there a voice level alignment procedure that can be used in all cases?

I started working on this problem years ago. At the time, my responsibilities included several radio communications base stations connected with four-

wire telephone circuits to various maintenance offices.

The users complained about high receiver levels and low transmitter levels. Technicians using a mobile radio through a base station repeater said the voice level of another mobile radio was loud enough but the voice level from a maintenance office was too low.

Interconnected telephone calls were difficult to hear.

A review of all the complaints indicated that the mobile radio users simply wanted all the voice levels from the mobile radio transmitters and the maintenance offices to sound the same or to be about the same volume.

Modulation reference

For FM radio communications transmitters, the maximum deviation the FCC allows is 5kHz. To avoid ever exceeding the legal deviation limit, most technicians set transmitters to a maximum deviation of 4.5kHz. Thus, 100% modulation = 4.5kHz deviation for most FM radio communications systems.

For two-wire, four-wire and other telephone circuits, 100% modulation is not as easy to define.

In mobile radio systems, 100% voice modulation levels at 4.5kHz deviation produces the same levels as transmitter and receiver VF test tones, but in telephone circuits, the average maximum

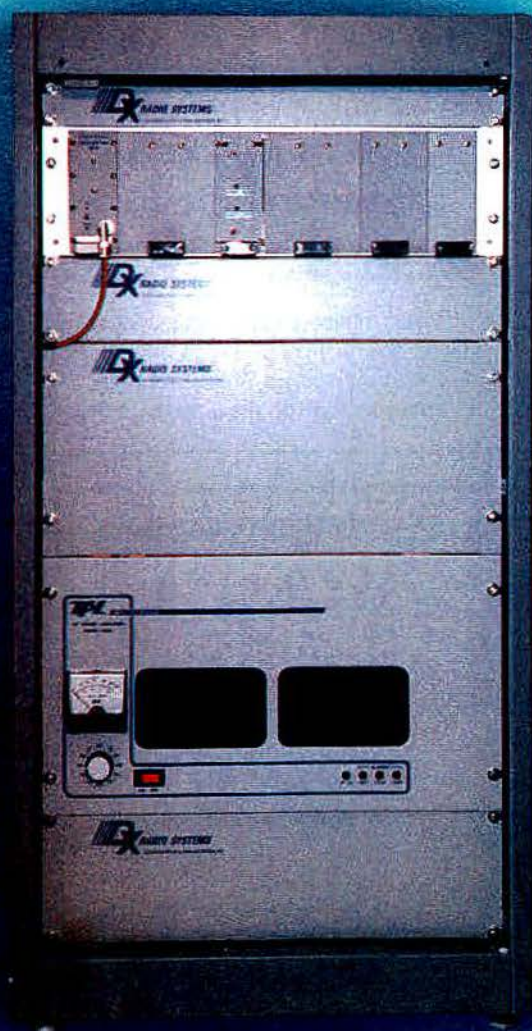
TELCO FOUR-WIRE CIRCUIT	BASE STATION
Example 1	
FOUR-WIRE OUT	TRANSMITTER VF IN
+7.0dBm (+1.0dBm) -----	(+1.0dBm) = 4.5kHz deviation
FOUR-WIRE IN	RECEIVER VF OUT
-16.0dBm (-22.0dBm) -----	4.5kHz deviation = (-22.0dBm)
Example 2	
FOUR-WIRE OUT	TRANSMITTER VF IN
0.0dBm (-6.0dBm) -----	(-6.0dBm) = 4.5kHz deviation
FOUR-WIRE IN	RECEIVER VF OUT
0.0dBm (-6.0dBm) -----	4.5kHz deviation = (-6.0dBm)
Example 3	
FOUR-WIRE OUT	TRANSMITTER VF IN
-4.0dBm (-10.0dBm) -----	(-10.0dBm) = 4.5kHz deviation
FOUR-WIRE IN	RECEIVER VF OUT
0.0dBm (-6.0dBm) -----	4.5kHz deviation = (-6.0dBm)

Figure 1. Some examples using the -6dBm0 modulation reference for four-wire telephone circuits. The -6dBm0 values are in parentheses.

Tice has 20 years of experience in communications electronics. He has worked as a broadcast station engineer and as a technician for GTE and AT&T, where he maintained central office, carrier, microwave, private branch exchange, key system and mobile radio base station equipment. He lives in West Salem, OH.

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voice level, or 100% modulation, is less than the VF test tones.

Research and testing indicate that a telephone circuit level of -6dBm , or 6dB below the VF test tone, is the best mobile radio 100% modulation reference.

One reference source states that a telephone call's average voice level is -15dBm with an average deviation of 6dB. Therefore, the average maximum voice level is $-15\text{dBm} + 6\text{dB}$ or -9dBm .

Another reference source suggests treating the voice level the same as the data level, which is -13dBm . Therefore, the average maximum voice level would be $-13\text{dBm} + 6\text{dB}$ or -7dBm .

A technician said that the obvious value is -6dBm . He said he was certain the radio system and telephone circuit VF levels were not the same. Although he had no documentation for his opinion, he said his 30 years of experience had shown the figure to be correct.

The base station VF levels were readjusted, and the telephone circuits were

tested at -9dBm , -7dBm and -6dBm , and several other levels.

The test at -6dBm as a 100% modulation reference was the most successful. A clerk at a maintenance office said the voice level was similar to a telephone call and just as clear.

Obtaining two-wire circuit loss information from a telephone company can be difficult. Start with the local business office if you have no engineering department contact.

When a telephone call was connected to the four-wire circuit, the voice levels were perfect in both directions.

Other tests involving a private branch

exchange (PBX) and an electronic key system (EKS) were just as successful.

System examples

Figure 1 on page 66 shows several examples for using the -6dBm modulation reference with four-wire telephone circuits.

A radio communications service company technician once explained that he sets VF levels when aligning a base station transmitter and receiver by feeding a 3.0kHz signal into the receiver and adjusting the output to 0dBm .

This procedure is inadequate because telephone central office lines have losses as great as 6.5dB or more. No single adjustment can be proper when the loss may range from 0.0dB to 6.5dB or more.

As for transmitter VF level adjustment, the technician apparently adjusted the transmitter deviation until the voice level sounded good to him.

Two-wire circuits

Using the -6dBm modulation reference for telephone central office two-wire dial circuits resembles the four-wire circuit examples.

The level used for the central office mainframe two-wire examples in Figure 2 on page 70 is 0.0dBm for two-wire out and two-wire in.

Obtaining two-wire circuit loss information from a telephone company can be difficult. Start with the local business office if you have no engineering department contact.

Ask for information about losses, loading, bridged taps, concentrators, two-wire amplifiers and other pair gain devices that affect loss calculations. You may need to provide your own two-wire and four-wire equalization equipment.

Central office loss and level information may be useful to other users of specialized two-wire services such as 9-1-1 and E-9-1-1.

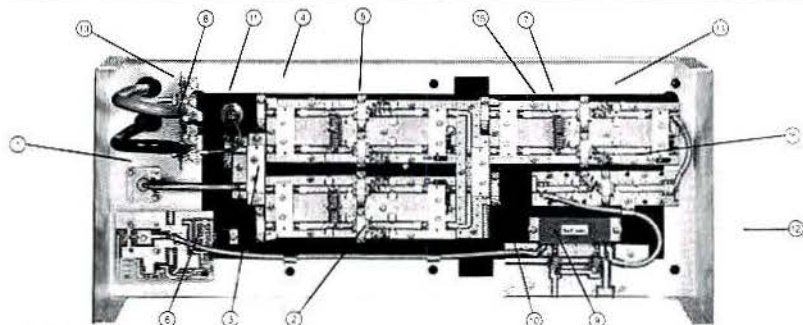
The answer is -6dBm

The telephone circuit level that equals 100% modulation in a mobile radio system is -6dBm .

This level permits automatic gain control (AGC) circuits to operate more effectively. The AGC gain adjustments should be no greater than 3dB to 6dB. If 6dB AGC gain is not enough, other level problems must be resolved.

When a -6dBm telephone circuit

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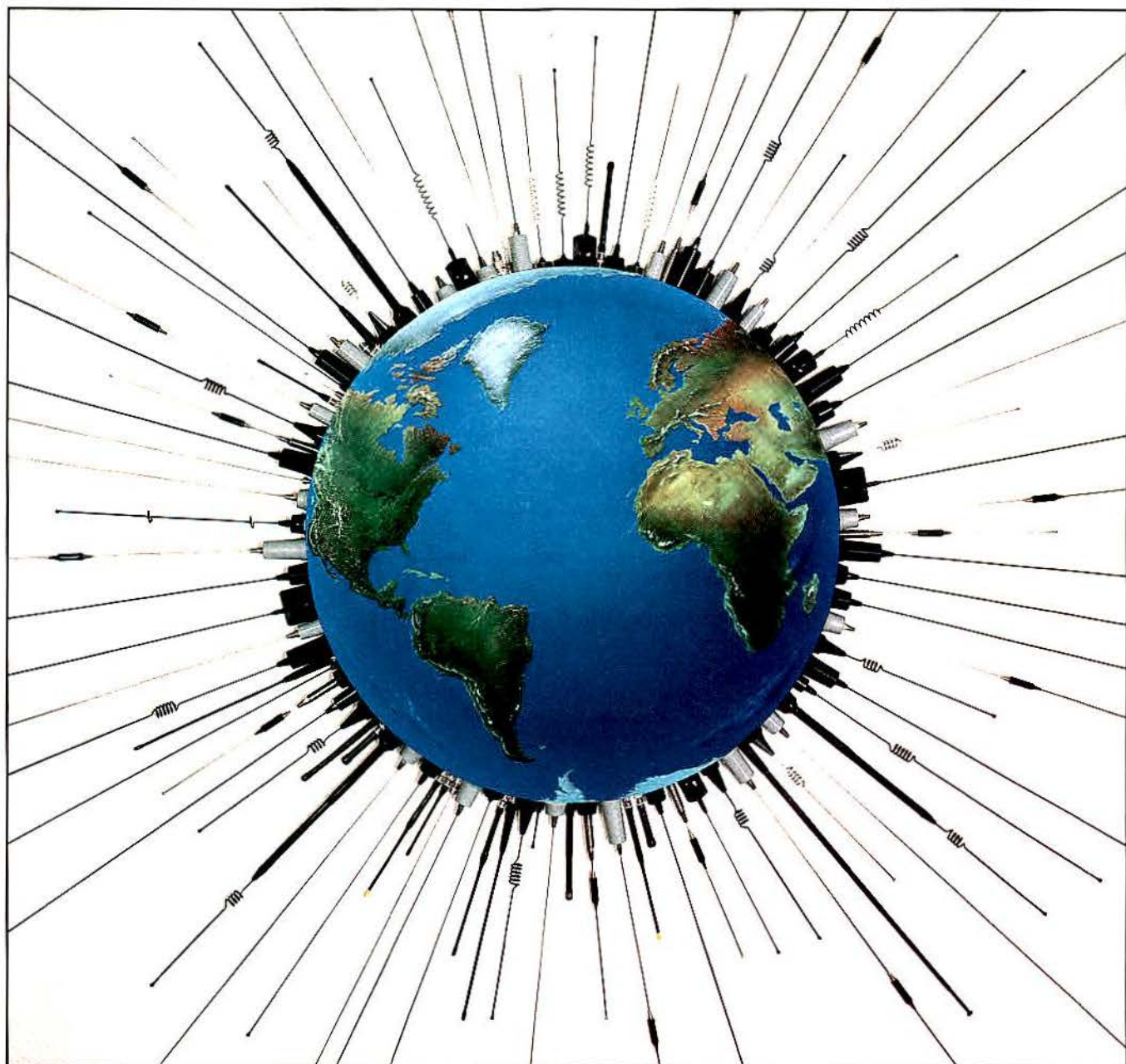
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CENTRAL OFFICE TWO-WIRE	LOSS	BASE STATION
Example 1		
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CENTRAL OFFICE TWO-WIRE IN 0.0dBm (-6.0dBm)	— 1.1dB —	RECEIVER VF OUTPUT 4.5kHz deviation = (-4.9dBm)
Example 2		
CENTRAL OFFICE TWO-WIRE OUT 0.0dBm (-6.0dBm)	— 3.0dB —	TRANSMITTER VF IN (-9.0dBm) = 4.5kHz deviation
CENTRAL OFFICE TWO-WIRE IN 0.0dBm (-6.0dBm)	— 3.0dB —	RECEIVER VF OUT 4.5kHz deviation = (-3.0kHz)
Example 3		
CENTRAL OFFICE TWO-WIRE OUT 0.0dBm (-6.0dBm)	— 5.4dB —	TRANSMITTER VF IN (-11.4dBm) = 4.5kHz deviation
CENTRAL OFFICE TWO-WIRE IN 0.0dBm (-6.0dBm)	— 5.4dB —	RECEIVER VF OUT 4.5kHz deviation = (-0.6dBm)

Figure 2. Some examples using the -6dBm0 modulation reference for two-wire telephone circuits. The -6dBm0 values are in parentheses.

level is used for lines connected to the mobile radio system, the voice levels from the telephone circuit to the mobile transmitters should result in a transmitter deviation of 3.0kHz to 4.5kHz.

Deviation outside this range may be

caused by telephone circuit levels that are outside the limits, an improperly adjusted mobile transmitter or microphone amplifier, or improper use of the microphone, such as the operator not speaking directly into it.

The next time you hear a mobile radio receiver and the voice level is lower than the squelch burst, adjust the transmitter and receiver 100% modulation VF test tone levels to the -6dBm0 levels of the telephone circuit to resolve the problem.

All system control tones must be referenced to -6dBm0. My practice is to adjust system control tones to -13dBm0 or -16dBm0.

When this alignment procedure is implemented, no control tone or voice level can exceed -6dBm0.

A deviation level no greater than 5kHz may be used instead of 4.5kHz for 100% modulation.

Warning: High levels on telephone circuits may cause impaired service.



Additional reading

O'Neill, John A., "What Techs Need To Know About Telco Line Testing," *Mobile Radio Technology*, April 1986. (Among its back issues, Intertec Publishing only stocks editions printed during the last two years. Reference copies of earlier editions may be available at some libraries.)

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Motorola, ARDIS expand U.S. public data network

The ARDIS nationwide public data network will expand with an infrastructure addition that operates on DataTrac, Motorola's high-speed 19.2Kbps protocol. The network is operating on a 4,800 baud protocol.

The system is designed to be flexible for the user. Customers should be

able to move from an area served by a 19.2/4.8 protocol to areas served by a 4.8 protocol only, and the new subscriber units will be compatible on either protocol.

ARDIS' five-year expansion plan includes adding more than 900 base stations across the country to broaden area

coverage. Washington, DC, San Francisco and New York will be the first cities to receive the new service. When completed, 25 to 30 cities will be operating on the dual protocol system.

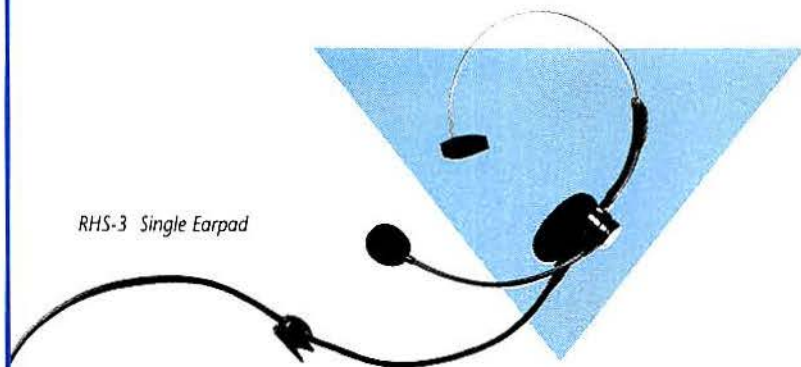
Motorola is in Schaumburg, IL. ARDIS is based in Lincolnshire, IL.

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N-W Group to acquire Glenayre Electronics

Glenayre and N-W Group have signed a letter of intent for N-W to acquire Glenayre's electronics manufacturing business for cash and N-W shares worth \$147 million. Glenayre senior management will own part of N-W after the closing.

The business will retain the Glenayre name and will be N-W's primary business. All Glenayre manufacturing employees and locations will be retained, including sales and operations offices worldwide. Charlotte, NC, will remain the world headquarters, and the Vancouver, British Columbia, operations will remain the Canadian headquarters.

Tall joins trade group as communications director

Robert E. Tall has joined the International Municipal Signal Association (IMSA), Newark, NY, as director of communications.

Tall's responsibilities include publishing, conference, educational, regulatory and public safety spectrum management activities.

Until retiring earlier this year from the Associated Public-Safety Communications Officers, South Daytona Beach, FL, Tall served as its executive director for eight years.

IMSA is a trade association that represents the interests of those who engineer, construct, operate and maintain electrical, electronic and graphic communications signals used in public safety services.

IMSA, together with the International Association of Fire Chiefs, coordinates frequency assignments for the Fire Radio Service and the emergency medical and response aspects of the Special Emergency Radio Service.



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Comcast to invest millions in Fleet Call

Comcast, Philadelphia, will invest as much as \$100 million in Fleet Call common shares under terms of a June 29 agreement. In addition, Comcast has purchased for \$20 million a five-year option to acquire an additional 25 million shares at \$16 per share.

Fleet Call is a multiple specialized mobile radio system operator based in Rutherford, NJ. Comcast operates multiple cable television and cellular telephone systems.

Ericsson increases ownership in Ericsson GE joint venture

Ericsson, Stockholm, will increase its stake in Ericsson GE Mobile Communications (EGE), Lynchburg, VA, from 60% to 80%, according to an agreement announced June 29.

EGE is a joint venture between Ericsson and General Electric, Fairfield, CT, whose interest in EGE will be reduced from 40% to 20%.

CMS opens two sales, support centers

Cable Management Systems (CMS), Santa Ana, CA, has opened two regional sales and support centers to provide customers with network design, site surveys, materials and installation of data communication networks. The eastern regional office is at 2914 Hamilton Dr., Voorhees, NJ 08043; phone 609-770-9195. The western regional office is at 1730 S. Amphlett St., Suite 319, San Mateo, CA 94402; telephone 415-578-1130.

Bowler Foundation selects award recipient

The Eugene C. Bowler Foundation has named Stephen L. Markendorff as this year's Eugene C. Bowler Award recipient. Markendorff has served as chief of the FCC's Cellular Radio Branch of the Mobile Services Division since 1987. He joined the FCC's Private Radio Bureau in 1967 and moved to the Common Carrier Bureau in 1980, where he played an integral role in the initial rulemakings establishing cellular service.

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So, when you need radios, call RELM Communications, Inc.

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The complete Mini-Com® Plus lineup also includes the PT Series* — PTV56 VHF and PTU46 UHF — portable radios and the SLU25* UHF mobile radio. These radios share the same features as the SLV40 and are available only from RELM Communications!

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* Manufacturers suggested retail price. Your price may vary. PT Series and SLU25 not for sale pending FCC approval.

Cable, cellular integration serves personal communications

A joint test project has integrated a cellular telephone base station with a fiber optic and coaxial cable personal communications transport system, according to Mark A. Coblitz, vice president of strategic planning at Comcast, Philadelphia.

Comcast, along with Motorola,

Schaumburg, IL, and Jerrold Communications, Hapsboro, PA, handled the test. The three companies have teamed to develop, test and evaluate a trial system of cable TV-transported personal communications services to on-street microcells and in-building picocells in the Trenton, NJ, area.

SAFECO ships access monitors for network testing

SAFECO, Chicago, has shipped NAMPS and TDMA versions of system access monitors for cellular network testing. The NAMPS version measures standard AMPS information plus bit error rate; narrow and wide channel numbers; signal strength of narrow and wide channels; digital signaling tone; and digital SAT.

The TDMA monitor measures standard AMPS information plus bit error rate, digital verification color code, time slot, signal strength and channel number.

ETrunk sues Midland over alleged patent infringement

ETrunk Systems, Yorktown, NY, has filed a patent infringement lawsuit against Midland International, Kansas City, MO.

Midland sells decentralized trunking mobile radio equipment that scans a pool of frequencies to find a vacant channel and signals other radios in a group to establish communications on that channel.

ETrunk alleges that the Midland equipment infringes on its patent for an invention entitled "Trunking Method and Apparatus for Establishing Communication in a Two-Way Radio System."

PacTel to license MicroCell technology

PacTel, Walnut Creek, CA, has licensed its MicroCell technology to Decibel Products, Dallas. The technology increases network capacity and provides coverage in areas that could not be served previously by traditional analog technology. Decibel will produce and sell equipment with PacTel's concept and software to the industry.

Use of the microcells, which are a fraction of the size of normal cells, can expand a cellular system's capacity by as many as two-and-one-half times because of higher reuse of voice channels than with conventional cells.

Microcell use allows a carrier to provide high-speed hand-offs of conversations from one microcell to the next or from microcells to macrocells.

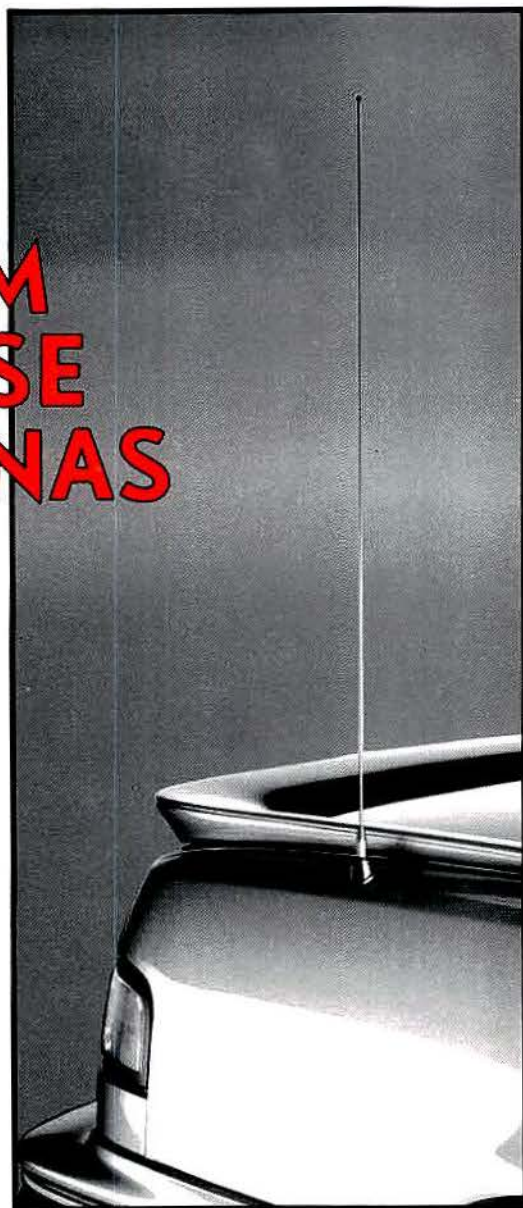
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Operation	Half-Duplex or Simplex
Protocol	Transparent to the User
Data Format	7 bits with even, odd, mark or space parity 8 bits with even, odd, mark, space parity or no parity
DTE Interface	RS-232 or TTL
Standby/RX Current Drain	32mA (RS-232) or 27mA (TTL)



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Specifications subject to change without notice.

Ad#RT911

Tessco to handle marketing for Celldyne

Tessco has obtained market and fulfillment functions for Celldyne cellular phone accessories. The line includes batteries, battery chargers and leather cases. New product design and development will continue to be handled under the Celldyne name as a unit of Tessco Technologies, Hunt Valley, MD.

Antenex expands, moves into larger office

Antenex moved into a high-tech facility three times larger than its previous office at the beginning of July. The high-tech manufacturing area and laboratory will allow the company to move ahead with its product development plans.

The facility features state-of-the-art

manufacturing test equipment, as well as larger offices, conference rooms, a combination kitchenette and lunchroom and a locker area.

The company grew 600% in the past year, outgrowing the old office. The increased space and improved equipment will allow faster order response time.

The high-tech facility is at 2000-200 Bloomingdale Road, Glendale, IL 60139. Telephone: 800-323-3757; fax: 800-851-9009.

Relm names Glenayre as Canadian importer

Relm Communications, Indianapolis, has named Glenayre Communications as the Canadian importer for its land mobile products to improve international sales in the Canadian market. Glenayre will be responsible for the importation, distribution, marketing and sales of Relm DOC-approved two-way radios, repeaters, base stations and LMC components within Canada.

A/S introduces guarantee on lifetime warranty

Antenna Specialists, Cleveland, has introduced a guarantee on the lifetime warranty for the On-Glass cellular mobile antennas. The antennas are warranted to be "free from defects in materials and workmanship, under normal use and service, for the lifetime of the original cellular mobile installation. Repair or replacement of the antenna will be made at no charge if the cellular On-Glass antenna fails to perform because of defective materials or workmanship."

Coded supplies LACTC

Coded Communications will supply equipment for a mobile data system for Los Angeles County Transportation Commission (LACTC), Los Angeles. Coded teamed with Ball Systems Engineering Division for the proposal. IQ-modems, radio system controllers, CMX-4000 mobile data terminals and system integrated services will be handled by Coded, Carlsbad, CA.

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using. This advanced logic controller has built-in audio companding, voice prompted interconnect, validation, airtime logging and much more. The TNT-100 is remotely programmable and is very user friendly. **See your revenues grow** as your customers enjoy the benefits of dispatch networking at any time, anywhere. The TNT-100 is also the first step in the new "Follow Me" roaming soon to be available. **No trade out to be made**, just add on as you grow!

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We've got a revolutionary, high-profit opportunity for a limited number of communications dealers in America and throughout the world. The new Patriot line of two-way radios.

Designed and built in the USA by Ritron, the Patriot radio has sleek lines and generously rounded edges, making it attractive as well as comfortable to hold and operate. Available in VHF and UHF bands, the Patriot radio is synthesized and field programmable. All Patriot radios feature 5 watts of power output, 10 channels and scan capability. And they're designed to withstand the high levels of shock and vibration required for MIL-STD 810 C&D certification.

We could go on and on listing the features, but you get the idea—they're loaded.

- To ensure maximum reliability and performance, the Patriot radio is manufactured using surface mount technology. And the uni-body housing is molded from an extremely tough polycarbonate material, for durability under rigorous conditions.

Now all we need are a few top-notch dealers. So if you've got what it takes to stand behind our Patriot, call us at: 1-800-USA-1-USA. In Indiana, please call: (317) 846-1201. FAX: (317) 846-4978. It just might make you a leader, yourself.

PATRIOT
BY RITRON

Fleet Call discontinues negotiations with AMS

Fleet Call, Rutherford, NJ, had signed a letter of intent with American Mobile Systems (AMS), Woodland Hills, CA, to acquire most of its assets, including its SMR licenses and businesses. The companies have discontinued negotiations, and Fleet Call no longer plans to acquire AMS' assets.

Under the agreement, Fleet Call would have exchanged 3.1 million new shares of Class A common stock for the AMS assets and would have assumed most of AMS' liabilities, including its outstanding bank debt. The value of the transaction was estimated at \$60 million.

Relm adds rep firms

Relm Communications, Indianapolis, has added Burtness Sales Associates and SPI Communications as independent manufacturers sales representatives. Minneapolis-based Burtness Sales Associates will be representing Relm's two-way land mobile products in Minnesota, North Dakota and South Dakota. Prairie Village, KS-based SPI will represent Relm two-way land mobile products in Iowa, Missouri, Kansas, the southern half of Illinois and eastern Nebraska.

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Broadcast Communications relocates its headquarters

Broadcast Communications Systems, a tower and antenna maintenance and construction company, has moved to new headquarters. The company has erected a 200-foot tower at the new location to support sales and training operations. The address and telephone numbers are P.O. Box 730, New Glarus, WI 53574; voice 608-527-5670; fax 608-527-5674.

Lindgren acquires welded enclosures firm

Lindgren RF Enclosures, Glendale Heights, IL, has purchased assets of LectroMagnetics, Los Angeles, a manufacturer of welded RF rooms and RF line filters for power, signal, data and control lines.

LectroMagnetics' primary market includes government, defense and commercial and industrial enclosure and filter sales. The sale marks the second West Coast business Lindgren has purchased in six months.

FL public utility installs radio data network system

To facilitate trouble call management, Florida Power & Light has installed a Comm-Rad radio data communications network system. The system provides the Miami public utility's vehicles with wireless and error-free remote access via modems into the company's mainframe computers. Comm-Rad, Atlanta, has had a test system installed in West Dade County in Florida since March 1991.



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590T – A DYNAMIC PERFORMER. The 590T, featuring a Shure amplified dynamic cartridge, is ideally suited to a wide range of mobile installations. Tailored frequency response provides optimum voice articulation while it discriminates against other sounds. The 590T is a workhorse designed to provide trouble-free service under the harshest conditions.

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TGA signs on RCCA as nationwide rep

TGA Systems, Atlanta, has selected RCCA as its nationwide representative for its paging terminal equipment and paging products. RCCA, Atlanta, has more than 70 sales representatives nationwide and concentrates on business and government agencies that sell and use land mobile products.

Bird presents awards to top distributors

Bird Electronic, Cleveland, has named three distributors to its 10th Club for outstanding performance. Awards went to M. Hutton, Dallas; Tessco, Hunt Valley, MD; and Henry Radio, Los Angeles. Henry Radio received recognition for leading all distributors in accumulated Bird product volume.

E. F. Johnson reaps state transportation pact

E. F. Johnson, Minneapolis, has received a contract from the Washington Department of Transportation for its Multi-Net trunked radio system. The six-year project includes four phases. The first phase includes 25 sites in the western part of the state and more than 500 mobile and portable transceivers.

By the completion of phase four, there will be more than 3,000 radios in operation statewide.

Seaboard names rep

Seaboard Electronics, New Rochelle, NY, and Carlsbad, CA, has selected Technical Services Company, Lombard, IL, to represent its product line. Seaboard products include long-range telemetry systems for remote location protection, transmitting measurement data, monitoring and controlling of equipment, mobile equipment protection and mobile personnel protection.

Ram, Simware team to provide data software

Simware, Ottawa, Ontario, has signed a pact with Ram Mobile Data, New York, to market connectivity software for Ram subscribers accessing IBM mainframe applications from PCs. The software will increase reliability, speed and response time.

Simware is packaging the software for Ram subscribers with its SplitSecond software for remote PC-to-mainframe data communications and its SimPC software for easier access to 3270 mainframe applications.

Dataradio teams up with GRiD Systems

Dataradio, Atlanta, and GRiD Systems, Fremont, CA, have combined mobile packet radio modems and laptop computers for data transmission. The Fremont Police use the combined equipment. They have GRiD laptops mounted in their patrol cars and use Dataradio's modem to transmit and receive data on the computer via radio signals. The modem and radios are in the vehicles' trunks.

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Choose from our full range of low band, VHF, UHF, and SMR antennas in unity, 3, 5, and 6dB gain, and say "no more" to your communication problems. Give us a call today.

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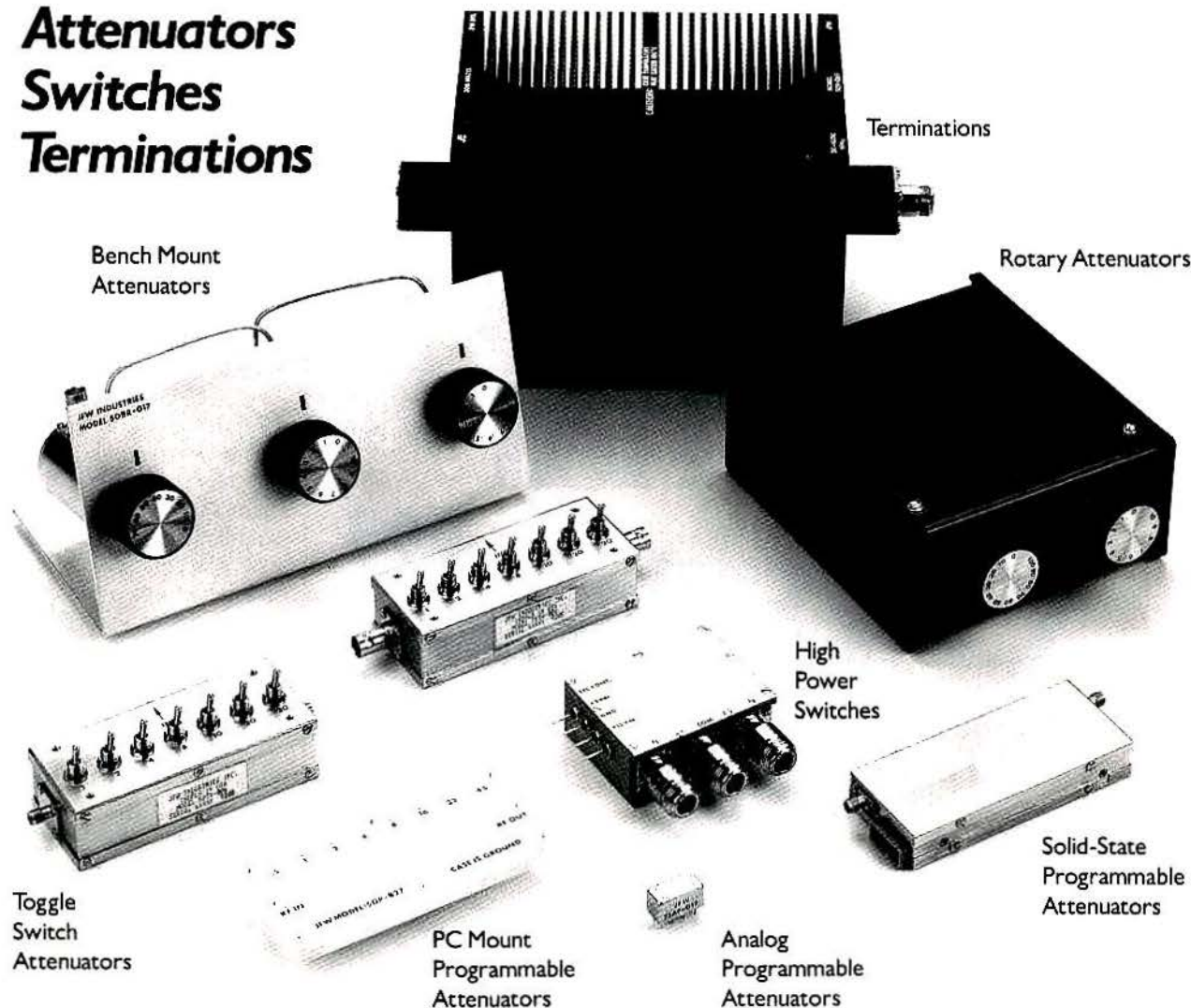
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Cellular survey: 'Dealers in dark about digital'

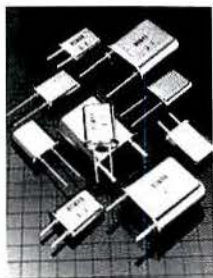
Most equipment dealers lack knowledge about digital cellular telephones, according to a survey conducted by Herschel Shostek Associates, Silver Spring, MD.

"The general lack of communications by carriers with dealers suggests many carriers have yet to form clear

plans for introducing digital to the market," Dr. Herschel Shostek said.

Should this lack of communications continue, Shostek anticipates early market confusion. He foresees that the confusion will contribute to what he anticipates will be a slower adoption of digital than popularly assumed.

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CMA matures, boasts 20-year history

The Communications Marketing Association (CMA) was created 20 years ago when a small group of industry members met and formed a group to promote discussions among representatives and manufacturers. In 1989, distributors were invited to attend for the first time.

CMA's aim is not to make policy or to lobby for any particular purpose. Its goal simply is to serve as an idea exchange forum, as well as to promote conversation with competitors and sales people from across the country all in the same setting.

The group's meetings are handled by volunteers and sponsorship of sessions and materials.

The 20th annual CMA meeting is set for Nov. 12-15 in Reno, NV. The conference includes formal training sessions covering the latest radio communications products and informal interaction sessions.

Independent representatives, manufacturers and distributors from all facets of the industry and from across the United States attend CMA's conference. CMA emphasizes the productivity that can be achieved through cooperation and communication among various groups in the two-way industry.

For more information, contact Gene Johnson at 818-442-0784.

Motorola recognized for crime prevention support

Motorola, Schaumburg, IL, was honored by the National Crime Prevention Council for its support as a key corporate partner in the development of two nationwide crime prevention programs.

The programs were designed to help consumers and law enforcement groups prevent violence, drug abuse and other community-level types of crime.

Motorola contributed to an anti-crime booklet, "Stop the Violence, Start Something." The mobile radio company funded a community crime prevention kit that provides information on prevention.

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OGB3-900 (740-251)	3 dBd	890-960 MHz	V	Radome-protected Collinear Dipole Array
OGB6-928 (740-195)	6 dBd	928-953 MHz	V	Radome-protected Collinear Dipole Array
OGB6-900 (K-7516641)	6 dBd	890-960 MHz	V	Radome-protected Collinear Dipole Array
OGB9-900 (740-189)	9 dBd	890-960 MHz	V	Radome-protected Collinear Dipole Array
SL-8 Paraslot®	11.5 dBd	928-953 MHz	H	Radome-protected Eight-Bay Slot Array

DIRECTIONAL ANTENNAS

<u>Model</u>	<u>Gain</u>	<u>Bandwidth</u>	<u>F/B</u>	<u>Pol</u>	<u>Type</u>
TY-900	10 dBd	890-960 MHz	20 dB	V/H	YAGI
RY-900	10 dBd	890-960 MHz	20 dB	V/H	Radome-protected YAGI
CL-900	8 dBd	800-960 MHz	35 dB	V/H	Radome-protected LOG
LP10-900 (K-732261)	10 dBd	790-960 MHz	25 dB	V/H	Radome-protected LOG
BP6-900 (A-6335641)	6 dBd	870-960 MHz	25 dB	V	Radome-protected PANEL
BP9-848 (740-217A)	9 dBd	790-960 MHz	20 dB	V	Radome-protected PANEL
BP11-875 (740-028)	11 dBd	790-960 MHz	20 dB	V	Radome-protected PANEL
BP13-875 (A-633061)	13 dBd	790-960 MHz	20 dB	V	Radome-protected PANEL
BP16-875 (740-215)	16 dBd	790-960 MHz	20 dB	V	Radome-protected PANEL
MF-900	14 dBd	890-960 MHz	23 dB	V	MINIFLECTOR®
PR-900	18 dBd	890-960 MHz	25 dB	V/H	PARAFLECTOR®

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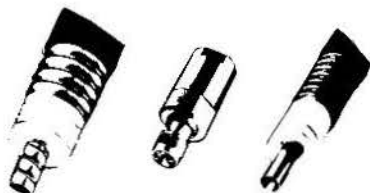
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ACT update

New certified technician exam procedures offer convenience, 60 test sites nationwide

By Thomas Green

During the May 7 ACT volunteer leadership council meeting, council members decided to contract with Plato Professional Development Centers to administer the NABER technician certification test.



Green

The new procedures have been streamlined.

► **More test sites**—Candidates can choose from 60 test sites across the country.

Because there are more test sites, the amount of travel time, travel expense and time away from work will decrease.

► **Continuous testing**—Instead of administering tests once every few months, Plato conducts tests Monday through Friday throughout the year.

Registration time has been decreased. Once candidates register with NABER, they can contact the testing center immediately to make an appointment.

► **Immediate results**—Instead of waiting four to eight weeks for exam results, candidates will be given their scores as soon as they complete the exam.

Because a substantial number of employers are requiring NABER certification during the job application period and for career advancement, both the candidate and the employer will benefit from having immediate access to test scores.

► **Re-examination**—A candidate who fails the exam can register with NABER again and retest during the same week.

Green is an instructor and communications manager of communications electronics at Ranken Technical College, St. Louis. He is ACT's volunteer leadership council chairman. ACT, the Association of Communications Technicians, is a membership section of NABER, the National Association of Business and Educational Radio.

► **Computerization**—Taking the test on the Plato system of microcomputer workstations is easy.

Users are not required to have microcomputer experience. Before taking the exam, an introductory lesson familiarizes the candidate with Plato system operation.

The Plato system has an easy-to-use, touch-sensitive screen that allows the candidate to answer questions simply by touching the proper area on the workstation screen.

Although NABER has made significant changes to the exam procedure, the exam's overall quality and content will remain the same.

Moreover, the *NABER Certification Examination Study Guide* will contain 150 sample questions (the actual number on the exam) that help to pinpoint those areas where candidates may need additional study.

Newsletters

All of NABER's individual membership section newsletters are being folded into the association's magazine, *Business Radio*.

Accordingly, material for ACT's *TechTalk* and *TechTalk Plus* newsletters will appear in *Business Radio* as the "Benchwork" and "Test Yourself" columns.



Information

For information about ACT and technician certification, call 800-759-0300. Ask for 'technician services.'



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The CR300 series can record up to 20 individual channels of audio. With TEAC'S VHS format your recordings are protected inside a compact cassette. So, you don't have to worry about all the problems of handling and storing tape reels.

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Cellular service expansion draws industry opposition

The FCC has received a petition that requests permission for cellular carriers to offer private, non-common carrier services, such as personal communications services (PCS) and dispatch services over their cellular systems. The petition was filed by Telocator, a Washington, DC-based trade association largely composed of common carrier system operators and licensees for experimental PCS systems.

Two trade associations based in Arlington, VA, the Council of Independent Communications Suppliers and the Special Industrial Radio Service Association, filed a joint statement with the FCC in opposition to Telocator's request.

The statement cites federal law that prohibits common carriers from providing dispatch services and regulatory and competitive reasons why common

carriers should not be allowed to use their resources to duplicate services provided by private radio licensees.

In addition, the statement reads that if cellular carriers have excess capacity that could be devoted to providing private services, the FCC should consider reallocating some of the cellular spectrum for private radio so everyone can apply for licenses to use it.

Trade group asks FCC to license wide-area systems

The National Association of Business and Educational Radio (NABER) has petitioned the Federal Communications Commission provide for the licensing of wide-area private land mobile radio systems to Business Radio Service (BRS) eligible entities and specialized mobile radio (SMR) systems.

According to current FCC rules, a

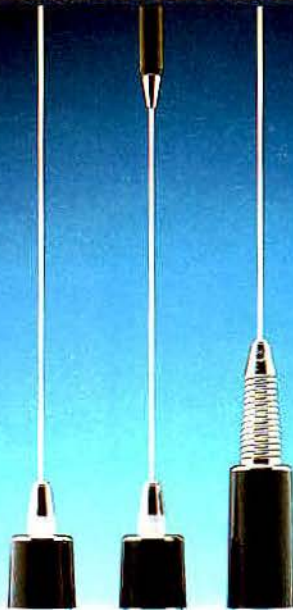
NABER document reads, wide-area systems are permitted for all categories of eligibles except SMR systems. Additionally, remote stations in wide-area systems licensed by BRS licensees are authorized only on a secondary basis. Regional SMR systems using the same frequency are not permitted without a waiver.

MTEL asks for license for national wireless web

Mobile Telecommunications Technologies (MTEL) has filed a petition asking the FCC the 930MHz-to-931MHz band for a new nationwide wireless network. The high-speed messaging service envisioned by MTEL would serve portable palmtop and notebook computers, as well as advanced paper-sized messaging devices.

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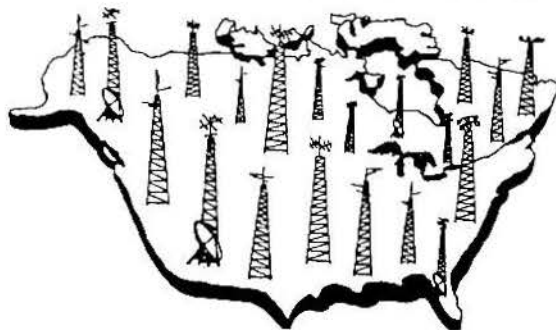
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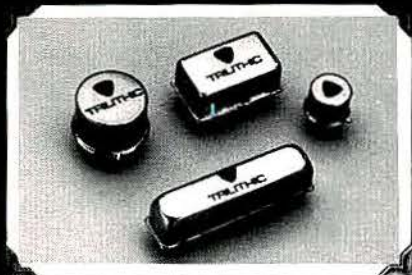
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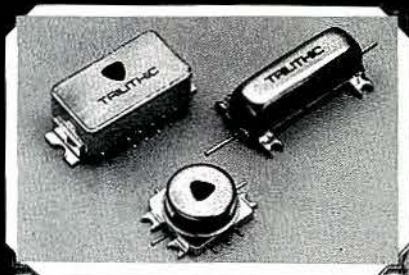
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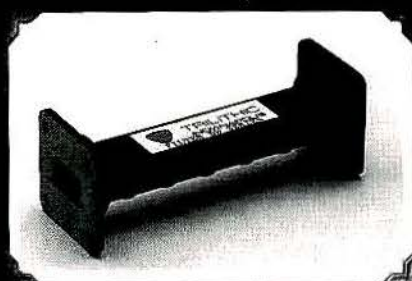
Miniature filters



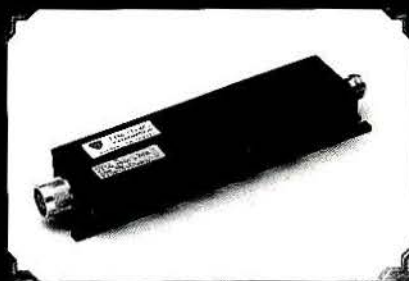
Surface mount filters



Tubular filters



Waveguide filters



Cavity filters



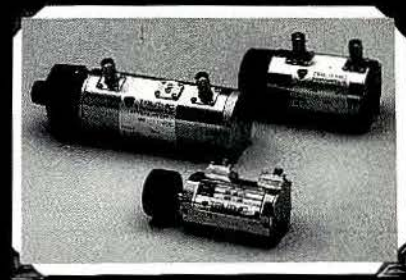
Tunable filters



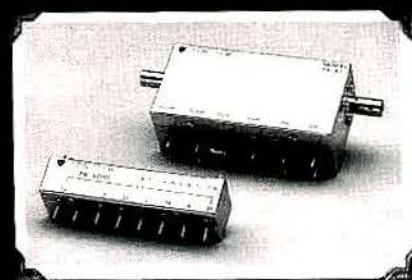
Coaxial attenuators



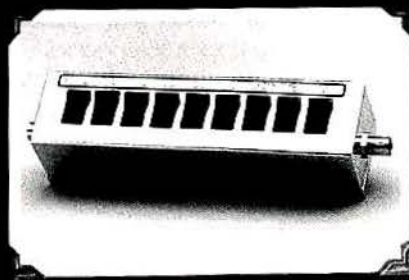
Pushbutton attenuators



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Regulating technology

Movie, TV alliance faults FCC *Report and Order*

The Alliance of Motion Picture and Television Producers (AMPTP) has asked the FCC to reconsider some aspects of its *Report and Order* in PR Docket No. 91-62 amending rules for the Motion Picture Radio Service.

The *Report* changed the name of the radio service to the Video Production Radio Service (VPRS). AMPTP wants it renamed as the Motion Picture and Television Radio Service. The alliance finds the FCC-initiated name-change "arbitrary" because the rulemaking proceeding sought no public comment on a name change.

The alliance wants the FCC to express more stringent limits on license eligibility than the *Report* provides. It

wants only parties that provide actual production-oriented support services to entities eligible for licenses under the previous rules to be extended eligibility under the new rules.

For example, the alliance wants the FCC to proclaim persons producing documentaries, special programs, music videos, educational programs and commercials as eligible for licenses.

According to AMPTP's document, an entity that provides sandwiches to a production company could obtain a license in the renamed VPRS. Such liberal eligibility could lead to spectrum congestion and be against the interests of VPRS licensees engaged in production activities.

SIRSA asks FCC to relax 900MHz loading rules

The Special Industrial Radio Service Association (SIRSA) has asked the FCC to relax its loading requirements for licensees operating on 900MHz frequencies allocated to the Industrial/Land Transportation Pool.

A SIRSA statement explains that the majority of these licensees are major corporations using their systems to conduct internal business communications so that goods and services may be provided to the American public as efficiently as possible.

The Washington, DC-based trade association encourages the commission to "recognize present-day economic and technical realities" and to grant a two-year extension for the loading deadlines.

Groups comment on changes to licensing, reporting

The National Association of Business and Educational Radio (NABER), Alexandria, VA, has filed comments with the FCC on PR Docket 92-78, which seeks to amend Part 90 of the FCC's rules concerning end-users and mobile licensing information.

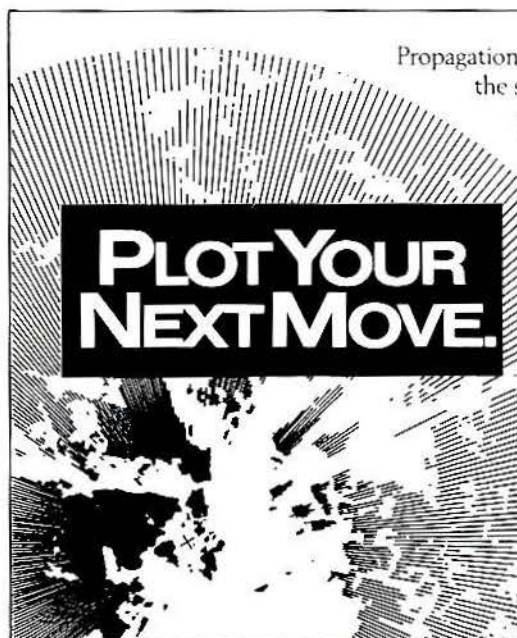
According to association president E.B. "Jay" Kitchen, "NABER supports the commission's efforts to make the licensing process more efficient and less costly for applicants. However, NABER is concerned that the provi-

sions set forth in the commission's current proposal would actually slow down the licensing process and hinder the coordinator's current ability to amicably resolve frequency disputes and correct applications before they ever reach the commission."

The Special Industrial Radio Service Association (SIRSA) and the Council of Independent Communications Suppliers (CICS), both based in Arlington, VA, support the proposals to eliminate additional licensing and reporting re-

quirements imposed on specialized mobile radio (SMR) system operators.

Nevertheless, the two trade groups urged the FCC to recognize that the lure of additional spectrum may tempt otherwise law-abiding SMR operators to use less than exacting methods in determining their mobile loading. Accordingly, SIRSA and CICS have recommended that the FCC require any assertions regarding loading data be sworn to and signed under penalty of perjury.



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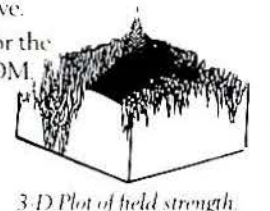
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3-D Plot of field strength.

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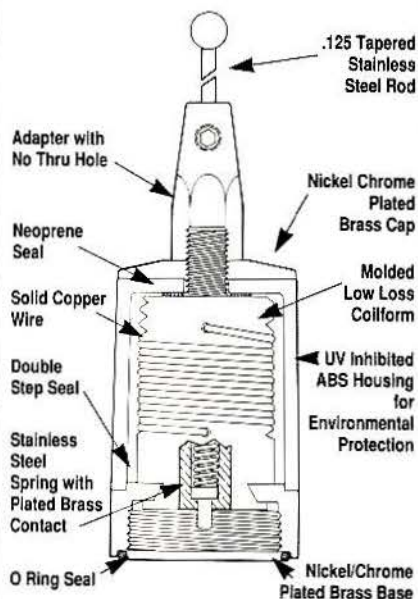
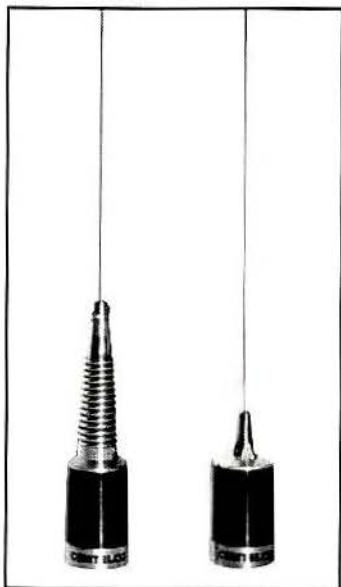
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Regulating technology

Reduced 800MHz loading requested for rural areas

Three trade associations jointly have asked the FCC to reduce loading requirements for exclusive-use 800MHz radio communications systems in rural areas. They asked that applicants for systems in the 806MHz-to-821MHz and 851MHz-to-865MHz bands be permitted:

► to obtain exclusive use of conventional channel assignments based on a loading criterion of 35 mobiles per channel.

► to include fixed transmitters in the "mobile loading" category.

► to obtain trunked channel assignments based on a loading criterion of 50 mobiles per channel.

► to certify that a minimum of 35 mobiles per channel will be in operation on trunked channel assignments within five years of license grant date.

The loading request was filed by the Council of Independent Communications Suppliers, the Special Industrial Radio Service Association and the Telephone Maintenance Frequency Advisory Committee, all based in Arlington, VA.

Private carriers seek exclusivity at 900MHz

Through its Association for Private Carrier Paging (APCP) membership section, the National Association of Business and Educational Radio (NABER) has asked the FCC to allocate certain 900MHz private carrier

paging frequencies for exclusive use by individual licensees in given areas. All private carrier frequencies presently are allocated for shared use by multiple licensees. NABER is based in Arlington, VA.

FCC extends deadlines for 900MHz SMR loading

The FCC has issued a notice in PR Docket No. 92-17 to extend the loading deadlines for Phase I 900MHz trunked SMR systems.

The commission will grant all trunked SMR licensees in the 806MHz-to-901MHz and 935MHz-to-

940MHz bands a two-year license renewal at the end of their initial license periods. At the expiration of the two-year renewal, licensees will be required to meet the loading requirements usually associated with the initial five-year license.

UHF-TV channel-sharers receive FCC reminder

The Federal Communications Commission has issued a public notice about shared use of UHF-TV channels by private land mobile radio licensees. The notice includes a list of TV stations requiring protection and their station coordinates. It reminds radio users to maintain fixed mileage separa-

tions from the transmitter sites of affected TV stations. The notice reads that questions about existing operations may be telephoned to the commission at 717-337-1411 or directed to the frequency coordinator for the particular radio service.

FCC grants four licenses for air-to-ground telephone

The FCC has granted licenses to four of six applicants for authority to offer air-to-ground telephone service. The four companies are American Skycell, Clairtel Communications Group, In-Flight Phone and Mobile Telecommu-

nications Technologies. Still pending are applications filed by Jet-Tel and GTE Airfone, which operates an air-to-ground telephone service under an experimental license.



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Readers' choice

Of all the new products and services in the February issue, the ones reprinted here generated the most reader requests for additional information. If you missed them the first time, here is your opportunity to acquire more information on them: Just circle the corresponding Fast Fact Card number on the card found in the back of this issue and mail the card to us.

ACSSB transceivers cover the 220MHz band

Model ESP500 ACSSB transceivers operate in the 220MHz-to-222MHz band. Three versions are available from SEA that feature field-programmability, CTCSS encode and decode, time-out timer and busy lockout programmable on a per-channel basis. Model ESP525DB is a four-channel version with an internal front-firing speaker and talk-around switch. Model ESP525DH is a 20-channel version with a built-in modem. All three versions are dash-mount radios.

Circle (513) on Fast Fact Card

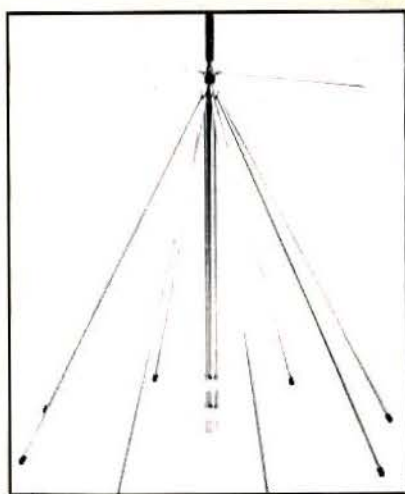
Solar electric generators come in 12Vdc, 24Vdc units

The Mini Sun Pak solar electric generators suit low- to moderate power requirements and come in 12Vdc and 24Vdc configurations with outputs starting at 5W. The Photocomm units include a 20-day maintenance-free battery as a reserve for use in inclement weather.



Circle (514) on Fast Fact Card

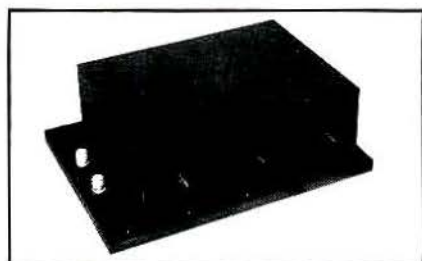
Wideband Tx, Rx antenna covers 100kHz to 1.3GHz



A wideband transmit and receive antenna from Ace Communications spans 100kHz to 1.3GHz. The antenna has eight horizontal radials, eight diagonal radials and a vertical top whip element. Input power rating is 200W with 50Ω impedance. The antenna comes with N and BNC connectors and 50 feet of coax.

Circle (512) on Fast Fact Card

Ceramic notch filter boasts low insertion loss



The SP9318 cellular site ceramic notch filter from Decibel Products allows system B extended range to receive 835MHz-to-849MHz frequencies while filtering out 845MHz-to-846.5MHz system A band frequencies. The filter features low insertion loss in the B-extended band and must be used in conjunction with a bandpass window filter.

Circle (219) on Fast Fact Card

Mobile data kits allow radios to interface MDTs

Mobile data kits from Midland LMR enable its VHF and UHF Syn-Tech XTR radios and its model 70-9150 800MHz radios to interface with Kustom DXT and KST MDTs and

Dataradio MRM and MDLC modems. The kits can be factory-installed in new radios or be retrofitted to existing radios in the field.

Circle (220) on Fast Fact Card

Computer-generated data includes HAAT, coverage contours

Computer-generated topographical and radiation data for the two-way, microwave radio and broadcast industries is available from Hartech. The consulting company can generate path

profiles, HAAT calculations and coverage map contours. Services include needs assessment, radio system design, system specifications, cost estimates and economic analyses.

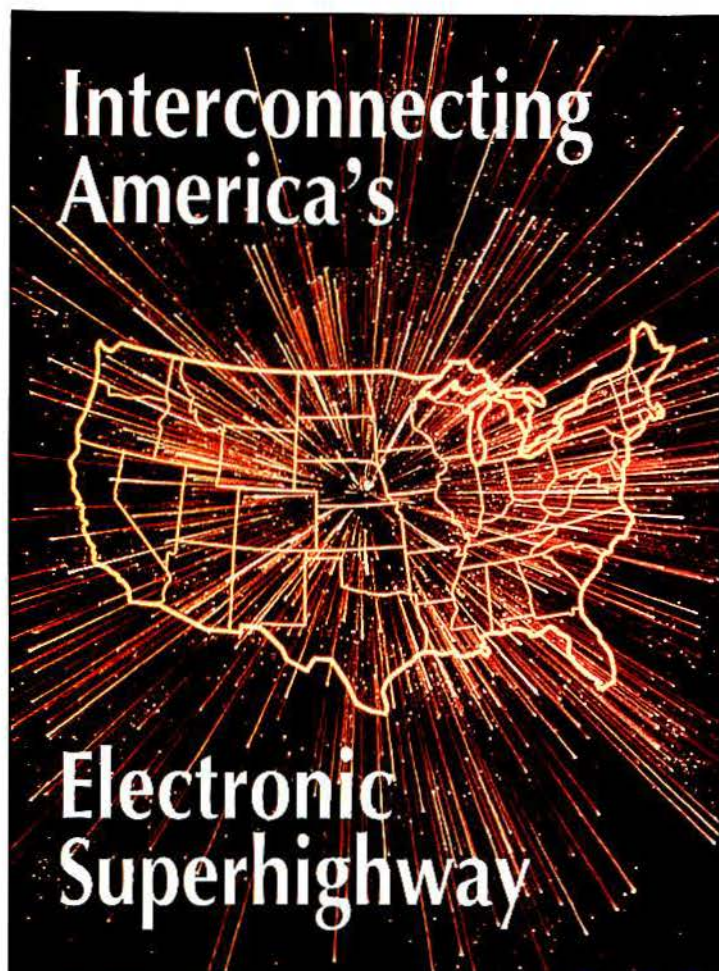
Circle (283) on Fast Fact Card

UHF mobile antennas feature European style

Three mobile antennas from Allgon in the 150MHz-to-450MHz range feature European styling in black stainless steel. The antennas come with

cutting charts for tuning the frequency. The low-profile antennas have a permanent base mount.

Circle (287) on Fast Fact Card



September 22, 1992
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The world may be evolving into the global village, but we are still traveling a bumpy road into the information age. Today's existing web of cellular, mobile radio, paging and telephone networks does not constitute the kind of powerful information infrastructure that we envision—no more than the thousands of US dirt roads in the early 1900s made a national highway system.

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Call 800/326-8638 or send a fax to 202/467-6987 to register. Seating will be limited at this one-time only executive forum. \$125 for Telocator members with convention registration, \$250 for non-members with convention registration.

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San Francisco
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8:30 AM

**Interconnecting
America's Electronic Superhighway**

Chairman:

Don Bishop, Editorial Director

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9:00 AM

**Where the Network is Going—
and What It Means for the Wireless Industry**

Moderator:

Tom Mateer

Manager of Strategic Development, Sprint

Don Gayton, Engineer, Glenayre Electronics

**Gary Jones, Director of Business Development,
PCN America**

**Clyde Smith, Director of Technology
Development & Service Applications,
Bell Atlantic Mobile**

**Harry Young, Director of Wireless Interconnection,
Bellcore**

10:30 AM

Coffee Break

10:45 AM

**Looking Ahead: The Economic Impact
of New Network Capabilities**

Moderator: Andrew Roscoe, President, EMCI

Joe Kellagher, Consultant, Arthur D. Little, Inc.

**John Reddy, Chairman of College of Business,
Penn State University**

E.Y. Snowden, Area Vice President, Pacific Bell

12:15 PM

Keynote Luncheon

2:00 PM

The Numbering Maze

Moderator: Kurt Maass

Vice President, McCaw Cellular

**Jim Dombrowski, Vice President of Technical
Operations, Skytel**

**Fred Gaechter, Member of Technical
Staff-NANP, Bellcore**

**Marsha Ochs, Director of External Affairs,
McCaw Cellular**

3:30 PM

Coffee Break

3:45 PM

The Regulatory Agenda

Moderator: Kevin Kelley

Vice President, Qualcomm

Debra Lagapa, Attorney, Morrison & Foerster

Ray Kimball, Attorney, Ross & Hardies

Mitchell Wilk, President, Wilk & Associates

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- Provides remote channel indication.
- Does not require B308 option.
- Remote transmissions heard over radio speaker.
- Radio transmissions monitored on remote speaker.
- Uses any two wire voice grade circuit.

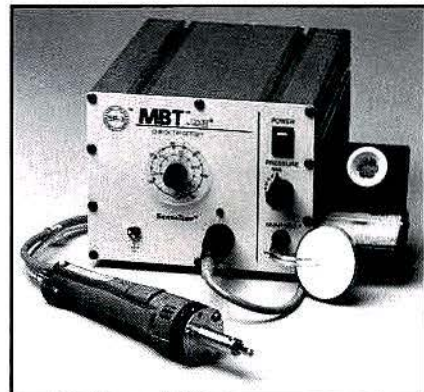


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New products

Desoldering station features upgradability



The MBT 101 self-contained desoldering station can be upgraded to perform SMT and through-hole component installation or removal. The Pace unit includes a desoldering pump and a solder extractor. The unit meets or exceeds military and civilian EOS/ESD standards and military standard 2000.

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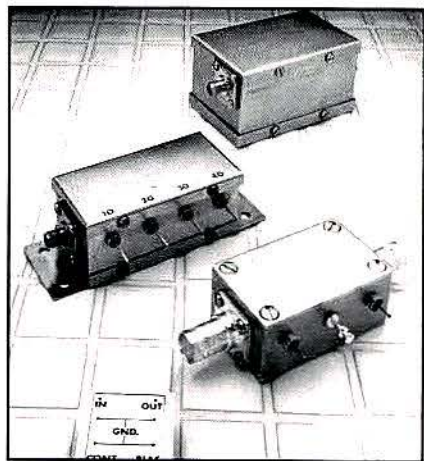
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Programmable attenuators cover wide range of specs

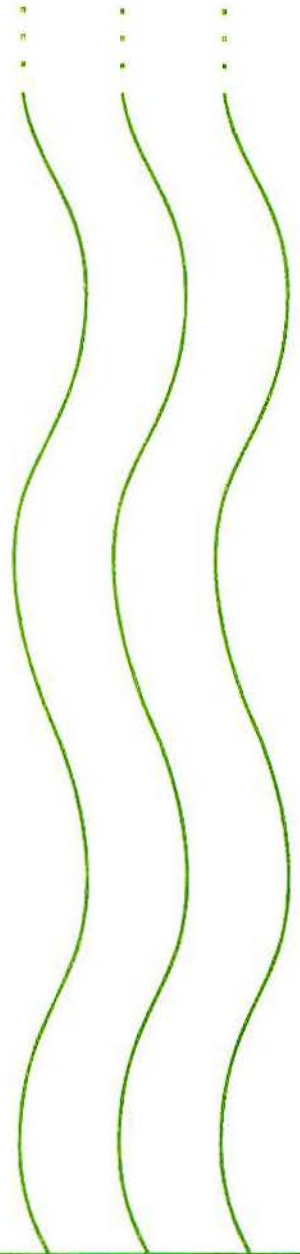


More than 850 programmable attenuators with 50Ω impedance and more than 100 models with 75Ω impedance are available from JFW Industries. The units are available in a wide range of specifications with various features such as high frequency range; phase constant; wideband; and fast switching speed.

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**MOBILE
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New products

VHF crystal portable comes with boom mic

The PCI-Vox crystal-controlled 1W portable radio offers hands-free operation and comes with a headset and boom mic. The Tekk radio has one channel and fits in a user's shirt pocket.



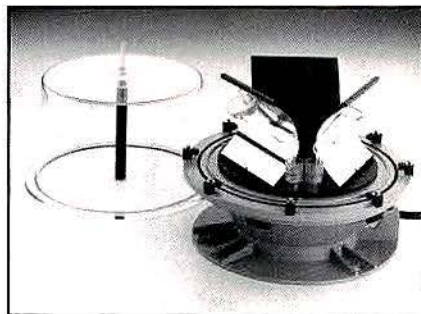
Circle (235) on Fast Fact Card

Coverage analysis module computes Carey contours

The coverage analysis module for the Professional Transmission Planner software from H2A Communications computes FCC FM, TV and Carey curve contours for as many as 360 radials from a transmitter. The module plots the contours to a variety of output devices. When the module is combined with Communications Data Services' terrain data, it will compute radial HAAT and plot radial coverage. Plots can include field strength levels, total losses, Fresnel zone shadowing and terrain elevations.

Circle (213) on Fast Fact Card

Obstruction warning beacon boasts 360° coverage



The FlashGuard obstruction warning beacon from EG&G Electro-Optics features three high-efficiency linear flashlamps with their own parabolic reflector. The medium-intensity beacon offers 360° coverage with a minimum of line input power. The lighting unit suits obstructions from 200 feet to 1,000 feet tall and can be placed along the tower or at the apex.

Circle (237) on Fast Fact Card

LCD frequency counter measures to 600MHz

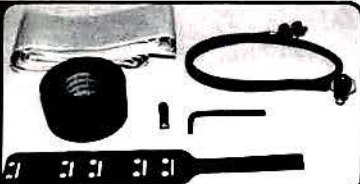
The MFJ-346 10-digit frequency counter from MFJ Enterprises measures frequencies to 600MHz. It uses a 9V battery or 12Vdc with optional accessory.

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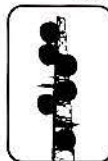


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New products

2W UHF hand-held comes with set of crystals

The Procom UHF hand-held transceiver boasts 2W and two channels. It comes with one set of crystals installed for the first channel. The **Fanon Courier** radio includes a channel selector switch, adjustable squelch control with tone squelch on-off, volume control and jacks for an ac charger. A rechargeable NiCd battery pack is included.



Circle (498) on Fast Fact Card

Tower lighting control system follows FCC, FAA rules

The Auto-Remote system from **Xcel Controls** monitors, controls, reports and documents tower lighting and security. The hardware and software system follows FAA and FCC regulations. The Control & Sentry Panel offers modular

control to fit specific needs. The stand-alone system controls and monitors as many as eight beacons. Alarm relays are included for each beacon, obstruction light, photo-cell and flash malfunction.

Circle (274) on Fast Fact Card

Ac power line protectors react quickly

The SPB ac power line protectors are UL listed and offer a one nanosecond component response time. The **MCG Surge Protection** units automatically reset after a transient has passed.

Circle (244) on Fast Fact Card



Digital voice logger offers simultaneous playback

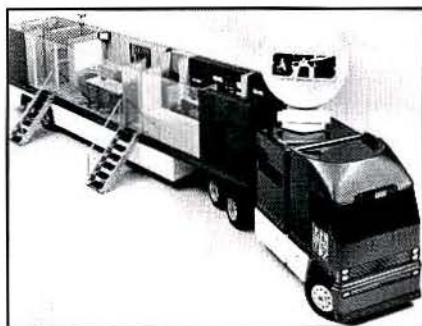
The digital voice logger from **Magnasync** features extensive storage; recall capability of as much as 10 years

of data; simultaneous record and playback of telephone and radio messages; and instant retrieval of data.

Circle (236) on Fast Fact Card

Mobile command center boasts self-contained design

A 45-foot tractor trailer houses the self-contained mobile emergency command center from **Skaggs Telecommunications Service**. The mobile center features a fully equipped operations center, technical command center, conference center, convenience modules for purposes such as snack areas, a bathroom and a rest and sleeping module. The center includes radio, telephone, computer, antenna, video, audio and power systems.



Circle (276) on Fast Fact Card

Paging, management system features inventory control

The communications resource manager paging and management system for a multi-user networked 486 micro-computer environment handles integrated customer service, billing, inventory and switch interface functions. The **Subscriber Computing** system incorporates cellular, paging and CT-2 capabilities on the same system and hardware.

Circle (273) on Fast Fact Card

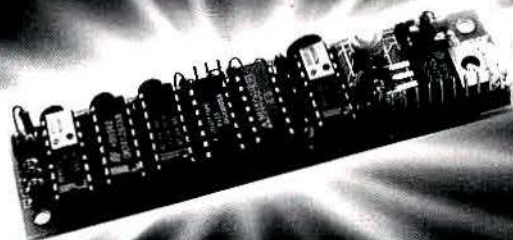
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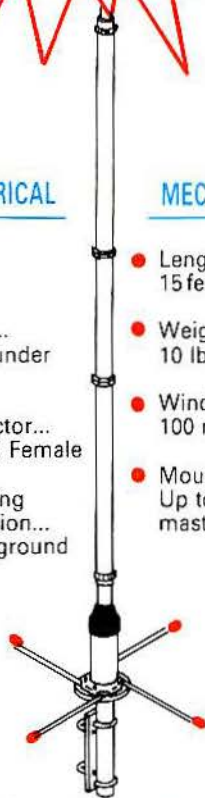


ELECTRICAL

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- Connector... Type N Female
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Circle (96) on Fast Fact Card

New products

Paging encoder sports remote control option



The PE-1000 paging encoder has a DTMF remote control capability option. The **Communications Specialists RC-1** remote control adapter allows DTMF from a remote location.

Circle (211) on Fast Fact Card

Cellular channel monitor decodes Tx HEX data words

The Cellscope 2000 cellular radio diagnostic monitoring system's software enhancement decodes in real time every HEX data word sent over any cellular radio channel. The **TSR Technologies** system logs and displays statistics; monitors user-selectable channels and scanning; and monitors base station and follows specific calls. The menu-driven software includes pop-up windows.

Circle (212) on Fast Fact Card

Battery kits fit cellular bag phones

Bag phone battery kits for most cellular transportables are available from **Multiplier**. The kits come with 2.3Ah lead acid battery and ac charger.

Circle (281) on Fast Fact Card

Horizontal mount holds multiple equipment

The Floormaster horizontal mount from **Gamber-Johnson** holds multiple communications equipment in place. The mount fits between a vehicle's seats or over the hump, depending on vehicle style. Front panels of the equipment face upward. Two to five radios, control heads or other equipment can be mounted. The mount is made of 11 gauge steel.

Circle (286) on Fast Fact Card



Mobile communications tower can be erected in minutes

The hydraulic quick-elevated tower from **FWT** can be elevated in less than two minutes and comes in heights to 80 feet. The tower resists twist and sway.



Circle (284) on Fast Fact Card

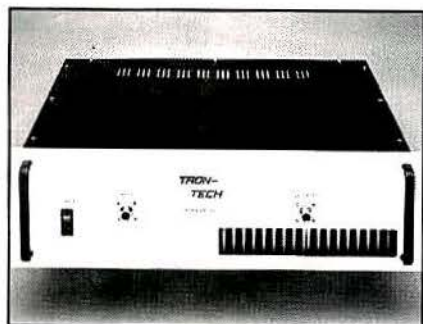
Fume extractor has 1,000W motor

The **Pace Mini-2** fume extractor has a 1,000W motor and a combination filter that houses HEPA and carbon elements. Filter condition is monitored constantly, and a warning light indicates a filter needs to be changed.



Circle (222) on Fast Fact Card

Power amplifier suits paging, cellular systems



The PIGA-33 2W Class A linear amplifier covers 10MHz to 1,000MHz. The Trontech unit features 30dB gain and suits paging services, cellular radio systems and test systems.

Circle (247) on Fast Fact Card

Mic cordsets plug into transceivers

Cordsets that are compatible with Ericsson GE MDS, Yaesu Vertex, Kenwood and Relm transceivers are available from Shure Brothers. The ModuLink mics plug into most brands of radios.



Circle (232) on Fast Fact Card

Communications shelter withstands 120mph winds

The Communications Building from Elite Buildings features polyurethane foam structural panels and a minimum R-11 wall and roof insulation, as well as R-21 insulation in the floor. The shelter withstands 120mph winds, roof loading

of 95 pounds per square foot and earthquakes with a zone 4 seismic rating. The equipment shelter can be ordered with a variety of exterior sidings, including metal, aggregate, brick stucco and wood.

Circle (217) on Fast Fact Card

UHF portable transceiver meets military, EIA specs

Model EPU 414 0A 4W and four-channel portable transceiver from Bendix/King covers the 450MHz-to-512MHz range. The UHF radio meets military standard 810C, D and E, as well as EIA and Forestry Service specifications for shock and vibration. The radio scans 50 channels per second, features a DTMF automatic number identifier and has programmable features. The unit includes CTCSS and CTCSS on a per-channel basis.



Circle (225) on Fast Fact Card

Vehicle routing system offers up-to-the-minute status

The Roadshow version 6.0 vehicle routing and scheduling system software handles route status monitoring, vehicle re-dispatching, five-day routes and multiple week delivery cycles. The Routing Technology Software management system provides up-to-the-minute status monitoring for every vehicle in the fleet.

Circle (239) on Fast Fact Card

Power inverters employ overload protection

Dc-to-ac power inverters from Tripp Lite incorporate frequency-controlled output, overload protection and high peak capacity. Model PV 600FC has 600W of continuous output power. Model PV 1200FC offers 1,200W of modified sine wave output power, polarity protection and a remote on-off interface.

Circle (246) on Fast Fact Card

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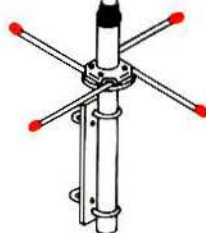


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- Lightning Protection... Direct ground

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Circle (97) on Fast Fact Card

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Circle (98) on Fast Fact Card

New products

Ear audio receiver enables discreet monitoring

The ELS2000 Earhanger audio receiver fits most hand-helds and allows discreet monitoring of radio transmissions. The Sonic Communications earpiece is lightweight.



Circle (277) on Fast Fact Card

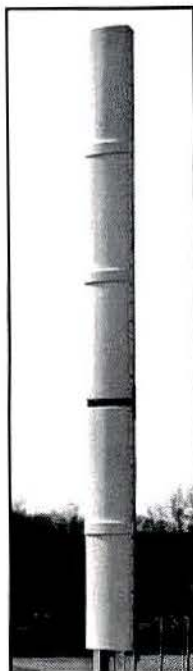
Updated trunk software supports more subscribers

The Console 4.0 software from Unipage supports four times as many subscribers as the previous version. The software provides additional functions for users with large systems and multiple trunk frames. The program operates faster than its predecessor.

Circle (241) on Fast Fact Card

17dBd gain panel antenna handles Tx, Rx on single unit

The 17dBd gain PD10219 directional panel antenna from Celwave suits applications in the 890 MHz to 960 MHz range. The wide bandwidth allows Tx and Rx on a single antenna. A side-fed dipole design, low-loss stripline feed, vertical beam width, 30dBd front-to-back ratio and 500W power input are features of the 62° antenna. The radome is housed in ABS plastic.



Circle (279) on Fast Fact Card

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Circle (99) on Fast Fact Card

Equipment shelter boasts flame-retardant design

A flame-retardant equipment shelter from **GFRC Shelters** is manufactured with a concrete aggregate exterior and a steel interior. It features a Unistrut equipment mounting system.



Circle (272) on Fast Fact Card

Tone remotes contain multifrequency options

The TSR90 tone remotes from **CPI Communications** come with multifrequency options for channel selection capability for a two- to 10-channel system.

Circle (215) on Fast Fact Card

High-powered isolator handles 500W input

The I-4130H isolator suits high-power paging communications applications and handles a 500W power input. The **Sinclair Radio Laboratories** isolator has a low insertion loss at 900MHz frequencies.

Circle (256) on Fast Fact Card



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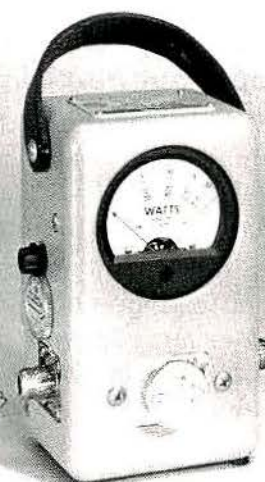


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Circle (101) on Fast Fact Card

New products

Programmable HF radio offers 10 channels



The TW2000S HF SSB radios from **Transworld** offer 10 channels over the 2MHz-to-20MHz range. Output power is 125W. The radios operate from a standard 12Vdc source.

Circle (505) on Fast Fact Card

Dualband antenna covers wide bandwidth

The KG 2/70 dualband glass-mount antenna from **Larsen Antennas** covers VHF and UHF over wide bandwidths. The antenna operates as a half wave on VHF and as a collinear on UHF, providing 2.5dBd and 4dBd gain respectively.



Circle (508) on Fast Fact Card

Grounding kit sports prepunched ground strap

The universal grounding kit for elliptical waveguide and coaxial cables on towers includes a prepunched copper ground strap to fit a broad range of cable sizes. The **CESCO** kit includes copper ground strap, instructions, 24 inches of grounding wire, special mastic tape, stainless steel hardware and electrical tape. Custom kits that meet specific needs are available.

Circle (252) on Fast Fact Card

Paging signal source benefits satellite system

The PageLock precision satellite delivered signal source and oscillator from **ISS Engineering** replaces the high-stability oscillator in the paging base station. The unit is combined with the

PageSat 200 satellite receive system to eliminate frequency errors and reduce maintenance costs, as well as to enhance simulcast operations.

Circle (486) on Fast Fact Card

Software enhances data radio networks

The WaveGuide software from **Motorola's Mobile Data Division** links PCs with wireless computing on most public shared and private data radio links. The software operates with Motorola's internal and external line of radio packet modems and DOS compatible computing devices.

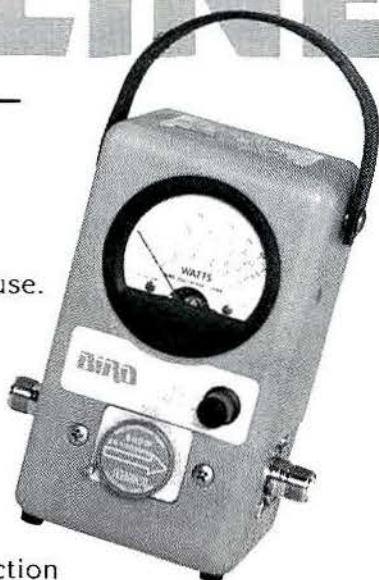
Circle (238) on Fast Fact Card

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Circle (103) on Fast Fact Card

Base station adapter boasts 8W audio amplifier



The SC101 station control allows the operation of a mobile radio as a remotely controllable base station. The Crescent Radio Electronics base station adapter features a 15A power supply, tone remote interface, solid-state switching, extended local control and an internal 8W audio amplifier.

Circle (242) on Fast Fact Card

Vehicular amplifier permits clear signal transmission



The Mobilcell bidirectional amplifier and repeater from Decibel Products permits cellular portables to be used in a car without signal loss due to tinted glass and steel. It is designed to prevent dropped calls, signal breakup and signal fading.

Circle (230) on Fast Fact Card

Voltage regulator suits rack-mount applications

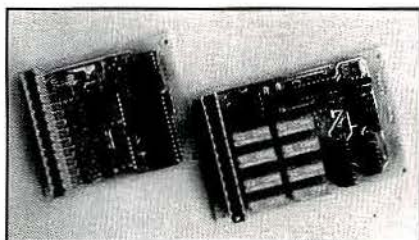
The LCR-2400 rack-mount line voltage regulator controls varying input voltages from 87Vac to 140Vac to protect sensitive equipment. The Tripp Lite unit features 2,400W output and 14 ac outlets.

Circle (234) on Fast Fact Card

'Building blocks' serve remote control purposes

Gronel Associates' System MX8 transmitter and receiver board are building blocks for remote control applications. The boards control as many as eight relays over a two-wire circuit and a control distance in excess of 2 miles.

Circle (500) on Fast Fact Card



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Circle (105) on Fast Fact Card

New products

Battery maintenance system includes NiCd conditioner



The HM System 90 battery maintenance system from **JaBro Batteries** analyzes, charges and conditions NiCd batteries and comes with various accessories, including software with full charge sensing algorithms. A universal adapter is available for the system that uses a clip lead interface and BCD rotary switch to condition four to 12 cell batteries.

Circle (221) on Fast Fact Card

Termination panels plug into remotes

The JM dc and tone termination panels plug into dc or tone remotes to various E. F. Johnson conventional and trunking mobiles when used as control stations. The **CPI Communications** remote panels offer remote and location operation; separate Tx and Rx amplification; and monitor and PTT functions.

Circle (216) on Fast Fact Card



Vehicle tracking system offers custom management

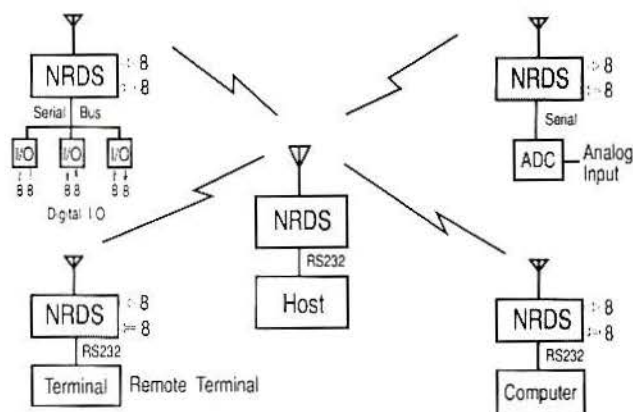


The Fleetservice vehicle dispatch and location systems from **Auto-Trac** offers fleet owners a custom-designed fleet management system. The system uses satellite, radio and computer technology to improve fleet dispatching, tracking and safety. The system can locate each vehicle in the fleet instantly to within 60 feet of its location and dispatch vehicles with accuracy. The system accommodates existing CAD systems.

Circle (240) on Fast Fact Card

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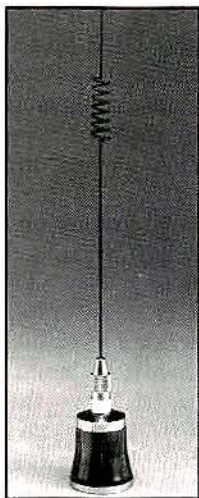
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ANI SYSTEMS

Circle (107) on Fast Fact Card

Unity gain antennas span 27MHz to 54MHz

Unity gain roof- and body-mount antennas from **Mobile Mark** cover 27MHz to 54MHz and come with a quick disconnect feature. The models include a spring-loaded center contactor and O-ring seal. The mobile antennas fit Motorola TAD/TAE mounts and a 3/4-inch hole.



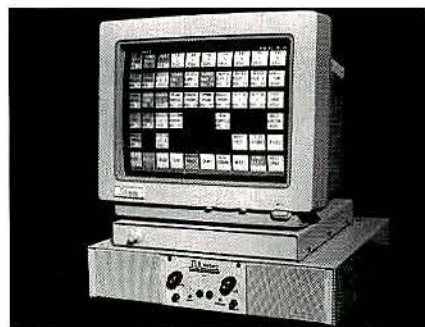
Circle (224) on Fast Fact Card

Alphanumeric display enhances mobile transceiver

The FMD mobile radio includes upgrades such as a system keypad and an alphanumeric display. The **Ericsson GE** model offers unlimited individual call capability. The eight-character display allows users to assign names for systems and groups. The FMD radios meet APCO 16 specs and military standard 810C and D.

Circle (451) on Fast Fact Card

Touch screen console includes enhanced features



The Touch Terminal display used on the ACCESS color touch screen console includes upgraded features from its predecessor. The Avtec terminal includes a larger screen, better display resolution and conveniently located operator controls.

Circle (280) on Fast Fact Card

Walk-in equipment cabinet meets custom specs

The 900 series walk-in cabinet from **Professional Systems** can be installed above or below ground. The equipment housing is available to meet custom

specifications such as cabinet dimensions, hardware, ventilation systems and equipment mounts.

Circle (269) on Fast Fact Card

Belt loop extends radio case 4 inches below user's waist

A belt loop for carrying cases from **A.W. Enterprises** extends a case 4 inches below a user's waist, allowing a comfortable toting position for the user, as well accessible access to equipment carried on the waist. The belt loop and carrying cases are made of durable leather.

Circle (255) on Fast Fact Card

UHF receiver multicouplers satisfy custom needs

The Custom Line of UHF receiver multicouplers from **Antenna Specialists** includes two basic designs—a base tray style and a tower amplified model. Users can specify the exact components to meet their system requirements. Four different preselector filters are available to meet precise frequency band, insertion loss and attenuation criteria. Power division options span four-way to 64-way configurations.

Circle (278) on Fast Fact Card

UPS system regulates ac voltage

The Omni 1350Lan features 1,200W and combines ac voltage regulation in a network compatible UPS system. The **Tripp Lite** unit corrects low voltage brownout conditions without switching to battery power. The UPS charges the battery during brownout conditions.



Circle (504) on Fast Fact Card

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Circle (108) on Fast Fact Card

New products

Self-tuning radio demodulates signals

The R-10 communications test receiver finds and demodulates signals. The Optoelectronics self-tuning unit features a built-in speaker and BNC out; 50Hz-to-5,000Hz demodulation; and search and lock-on modes.

Circle (231) on Fast Fact Card



Splash-proof headset works in moderate to high noise



A splash-proof headset with a strap-on boom mic allows the monitoring of radio signals in moderate to high noise. The T.E.A. headset has a PTT switch. Model 2495 has a noise-canceling electret mic; model 1412 is submersible to 10 feet.

Circle (229) on Fast Fact Card

Leather cases boast protective padding

Cellular telephone cases are available from db Mobile in soft full grain black leather. The cases have a protective

padding inside and come with a leather-covered belt clip.

Circle (254) on Fast Fact Card

UHF broadband antennas cover 406MHz to 512MHz

The XXX-S-450 UHF broadband disguised antennas suit most Ford, Chrysler and GM models and offer rugged, taper-ground and solid stainless steel masts. The STI-CO antennas cover a minimum 20MHz bandwidth in the 406MHz to 512MHz range. The fender-mount vehicular antennas resemble AM/FM entertainment radio antennas. They are weather-sealed for protection against moisture and corrosion.

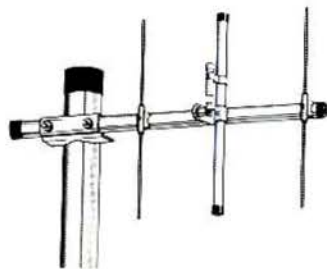
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Circle (117) on Fast Fact Card

Wideband portables feature front keypad controls

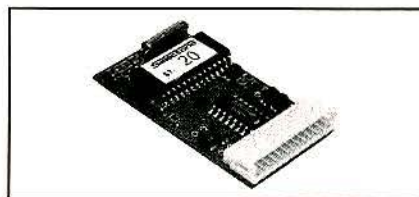
Model 70-165 VHF and model 70-265 UHF FM portable transceivers come with a function keypad and LCD as standard. The 48- and 99-channel handhelds have built-in 40-channel-per-second scan. RF output in the **Midland LMR** portables is 5W switchable to 1W in VHF models and 4W switchable to 1W in UHF. Both have front keypad controls.

Circle (218) on Fast Fact Card



Speech inversion scrambler suits most radio systems

The ST-20 inversion scrambler from **Selectone** features small size and low power consumption. The unit contains a clear/ciphered input as the only user control. It suits most radio communications systems, including trunked systems and repeaters.



Circle (243) on Fast Fact Card

Feature allows retrieval of alphanumeric messages

The Page Listen feature allows subscribers to listen and retrieve alphanumeric messages. The **MobileComm** feature allows subscribers to review or resend messages up to three days old from a standard Touch-Tone phone. Page Listen is part of the company's

Nationwide Messaging Page Management option. Along with Page Listen, subscribers can use Page Hold, which holds messages for as long as two weeks; Page Release releases messages before Page Hold time expires; Message Saver is a voice mail service.

Circle (202) on Fast Fact Card

Vehicular repeater system suits EMS applications

The EMS1000 vehicular radio repeater system from **Teletec** enables a communications link to be established from a patient's side via a portable radio with a DTMF pad. The system will repeat on all 10 UHF Med channels. The system allows the radio to operate as a regular simplex unit when communicating directly from the vehicle to the hospital. In addition to the Med chan-



nels, the system operates on any frequency from 450MHz to 480MHz.

Circle (275) on Fast Fact Card

Ac power line protector features low profile



Model 415 ac power line protector from **MCG Surge Protection** features a low profile and field repairability. The protector responds in less than one nanosecond and features impulse filtering.

Circle (245) on Fast Fact Card

Tone termination panel comes in 4, 6, 8, 10 channels

The TTP-Multifunction tone termination panel comes in four-, six-, eight- and 10-channel configurations from **CPI Communications**. The panel includes LED indication of PTT, monitor and channel.



Circle (248) on Fast Fact Card

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Circle (110) on Fast Fact Card

New products

Metal cabinet conceals dc power supplies

The PR series dc power supplies feature crowbar protection, IC voltage regulation, automatic overcurrent protection and full line isolation. The **Tripp Lite** supplies are housed in a dark metal cabinet and are available in 3A to 6A sizes.

Circle (233) on Fast Fact Card



RF calorimeter measures 200W power

Model 6091 calorimeter from **Bird Electronic** measures as much as 200W of dc through 2.5GHz RF power. Re-

sponse time is less than one minute to reach 97% of final reading.

Circle (253) on Fast Fact Card

Repeater controller aids microwave multidrop systems

Model 47MR multidrop repeater manager ties radio repeaters into a microwave system and features a four-wire audio port to provide the connection to the microwave or leased line path. The **Zetron** repeater controller includes a built-in RS-232 port, a built-in modem and programmability of as many as 20 speed-dial numbers.



Circle (449) on Fast Fact Card

VOX accessory comes in water-resistant case

The **Voxpak** fits portables and comes in a water-resistant case. The **Earmark** VOX accessory reacts only to voice, not to surrounding noise, and it automatically adjusts to the noise in a user's working environment.

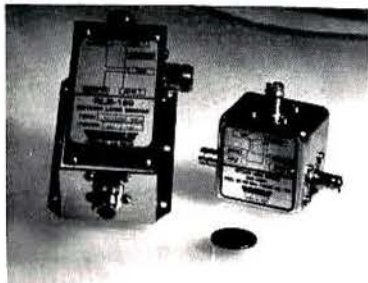
Circle (250) on Fast Fact Card



Trunked radio system supports UHF, VHF users

The second-generation digital access system from **Ericsson GE** allows VHF and UHF trunked use. The trunked system features fault-tolerant capability.

Circle (310) on Fast Fact Card



Return Loss Bridges

RLB150 bridges are a high accuracy low cost solution to SWR measurements. They can be used with spectrum analyzer/tracking generator for swept SWR measurements. EAGLE RLBs have these features:

- Frequencies: .04 Mhz to 1.0 GHz
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Circle (111) on Fast Fact Card

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Circle (112) on Fast Fact Card

Wall chart assists in antenna selection

As an aid for its customers in selecting the right antenna for vehicular installation requirements, **Antenna Specialists** offers a full-color illustrated wall chart. The "Professional Mobile Antenna Guide" shows about 150 mobile antenna models grouped by frequency range from lowband through 800MHz to 900MHz.

The antennas are cross-referenced to vehicle mounting schemes such as on-glass, conversion mounts, 3/4-inch and 3/8-inch hole mounts, trunk lid, magnetic and other temporary mounts. Included are antenna solutions for special applications such as transit, motorcycle and railroad uses.

Circle (400) on Fast Fact Card

Book explains facility planning

Facility Planning for Communications Centers by Alan Burton is a 71-page book that explains how to plan construction of communications dispatch centers. The publication from

Dispatch Specialists covers the use of consultants; site, interior and exterior considerations; alternative configurations; and standards and guidelines.

Circle (402) on Fast Fact Card

Handbook describes interference phase cancellation

The IPC/92 handbook describes interference phase cancellation, a practical method for suppressing interference that occurs at the same frequency as the desired signal or that occurs so close that application of conventional filters is impractical. The handbook from **Microwave Filter** describes the six most common interference prob-

lems, 15 different examples, solutions and product instructions. Co-channel reception, ghosting due to reflection, in-channel harmonic reception, wideband noise across lowband channels, undesired adjacent FM carriers and microwave in-band interference are areas discussed.

Circle (403) on Fast Fact Card

Catalog features soldering equipment

An eight-page catalog describes the full line of Antex soldering equipment. The catalog, offered by **M.M. Newman**, features precision miniature soldering irons, standard size irons, temperature control stations, power supplies, various tips, sponge trays and

stands. The catalog includes specifications for each soldering iron, temperature control station and power supply, as well as illustrations of the different tip styles offered.

Circle (404) on Fast Fact Card



INTERFERENCE LOCATION



- ★ 50 to 1000 MHZ
- ★ Stuck Microphones
- ★ Cable TV Leaks
- ★ Jammed Repeaters & Cell Sites



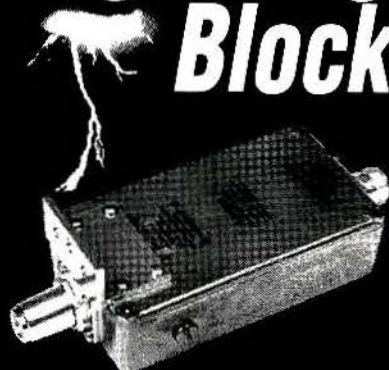
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Circle (113) on Fast Fact Card

'Computers will transform mobile radio'

Computers will transform mobile radio, according to 93.9% of the respondents to the February "What Do You Think?" questionnaire. Readers believe computers will transform mobile radio in the following capacities:

- "Data communications will replace as much as 80% of present voice traffic. It is faster and more accurate."
- "Digital technology improves the quality of Tx, Rx, processing and interface with other technologies."
- "It will make possible the mobile office."
- "More than 50% of all 'over-the-air' signals will be digital within 10 years."
- "Mobile dispatch, mobile data, data interrogation."
- "Programming radios, passing data through radio system for law enforcement, dispatching, persons and tag checks, data for utility users."

Technologies readers desire to be

integrated with computers are reported in the following statistics with multiple responses adding up to more than 100%:

TECHNOLOGIES MERGED WITH COMPUTERS	READERS' RESPONSES
Paging	57.1%
Mobile data terminals	83.7%
Automatic vehicle location	75.5%
Mobile radio	67.3%
Cellular	51.0%
Specialized mobile radio	51.0%
Other	18.4%

Using computers with radio-based technologies is advantageous for im-

proved productivity, radio channel efficiency and real-time response, report the majority of respondents. Radio data transmission is a thriving market for data and paging, according to 63.3% of the respondents.

Advantages and uses of data transmission include:

- "Cost reductions, simpler product."
- "Radio data will replace some wireline communications."
- "The need for real-time, error-free data transfer is needed in today's business environment."
- "Utility metering, data transmission, street and highway mapping and vehicle performance tracking" are uses for data transmission.
- "Costs are much less than running wireline and fiber."
- "Cellular fax, paging phone numbers, mobile message centers and real-time tracking" are uses for data Tx.



Cellular carrier info... as close as your computer!

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The same information you have come to rely on in *Cellular Business* magazine's "Calling All Carriers" in the May issue is now available on computer diskette. This directory includes carrier names, addresses, telephone numbers and fax numbers (when available) of the 306 metropolitan statistical areas (MSAs) and 428 rural service areas (RSAs). The directory is available in ASCII format so that it can be adapted to any computer program. Complete on one diskette.



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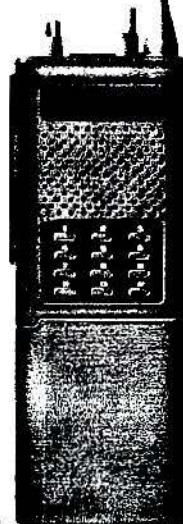
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Appointments at RF Industries (RFI), San Diego:

Les Perlman departs Particle Diagnostic, San Diego, as vice president of marketing to become marketing director at RFI.

Ron Workman exits Loral, San Diego, as purchasing supervisor to become RFI's director of purchasing.

Larry Johnson leaves Loral as engineer technician to join RFI as chief design engineer.

Terrie Gross departs Clinical Pharmaceuticals, San Diego, as data processing supervisor to become inventory manager at RFI.

R.J. LaFay exits NCR, Tokyo, as product manager to become OEM sales representative at RFI.

Appointments at Rochester Tel Mobile Communications, Rochester, NY:

Michael Herron, a private contractor for Rochester Tel Mobile Communications, joins the company in outside sales.

Michael Kristan exits RCI Long Distance, Rochester, a Rochester Tel subsidiary, as a customer care representative to take a position in inside sales at Rochester Tel.

Peter B. Rachor leaves British Telecom Mobile, London, as general manager of paging to join Mobile Telecommunication Technologies International, Jackson, MS, as vice president-Asia.

William J. Laggett, president of Centel Cellular, Chicago, has been elected chairman of the Cellular Telecommunications Industry Association (CTIA) board of directors. He succeeds **William B. Ginsberg**, president of Cellular Communications, Laguna Hills, CA.

Ted Rappaport, associate professor of electrical engineering at Virginia Tech, Blacksburg, VA, receives one of 15 Presidential Faculty Fellow Awards presented to outstanding young engineers. The award includes a grant of \$100,000 per year for five years, administered by the National Science Foundation.

Ann Mascione leaves A-line, Philadelphia, as credit and customer service manager to join Stinson Associates, Havertown, PA, as inside sales coordinator.

Appointments at Uniden America, Fort Worth, TX:

Pete Kavanaugh moves up from Midwest regional director of sales and marketing in Uniden's Cellular and Paging Division to become the Paging Division's vice president.

Judy Mitchell advances from telemarketing sales manager for the Paging Division's domestic operations to become the division's international sales manager.

Gary L. Ponzurick exits American Paging in St. Louis as general manager to become Midwest regional sales manager of Uniden's Paging Division.

David Dunlap departs PagePrompt USA in Los Angeles as operations vice president to join Uniden's Paging Division as West regional sales manager.

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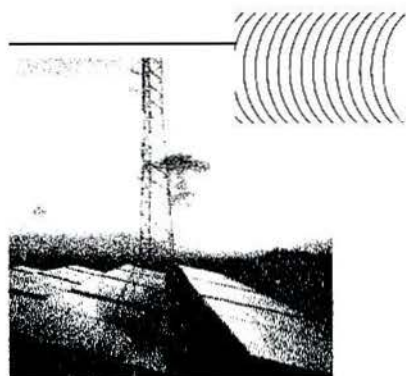
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Calendar

September

1-3—International Mobile Communications Expo/Fall, Georgia World Congress Center, Atlanta. Contact: 303-220-0600.

22-25—Mobile Communications Marketplace, Moscone Center, San Francisco. Contact: Telocator, 800-326-8638.

29-Oct. 2—International Conference on Universal Personal Communications, sponsored by IEEE, Loews Anatole Hotel, Dallas. Contact: Dhawal Moghe, 214-684-4506.

October

8-10—Special Industrial Radio Service Association Annual Meeting, Grove Park Inn, Asheville, NC. Contact: Barbara J. Levermann, 703-528-5115.

24-29—International Association of Chiefs of Police 98th Annual Conference, Detroit and Windsor, Ontario. Contact: 703-243-6500.

November

12-15—Communications Marketing Conference, John Ascauga's Nugget Hotel, Reno, NV. Contact: Gene Johnson, Vega Signaling, 818-442-0782.

20—Radio Club of America Annual Meeting and Awards Banquet, New York Athletic Club, New York. Contact: 201-652-6811.

1993

February

1-2—AMTEX '93, AMTA's Marketing and Technology Conference and Exposition, New Orleans. Contact: 202-331-7773.

March

3-5—Cellular Telecommunications Industry Association 1993 Winter Meeting and Exposition, Dallas Convention Center, Dallas. Contact: 202-785-0081.

21-24—Energy Telecommunications and Electrical Association '93, New Orleans Convention Center, New Orleans. Contact: 214-235-0655.

23-25—International Mobile Communications Expo/Spring, Anaheim Convention Center, Anaheim, CA. Contact: 303-220-0600.

April

19-22—Supercomm '93 and Telocator Spring Conference, Georgia World Congress Center, Atlanta. Contact: 800-326-8638.

May

18-20—Vehicular Technology Conference, sponsored by IEEE Vehicular Technology Society, Meadowlands Hilton, Secaucus, NJ. Contact: George D. Gaul, 908-290-1128; fax 908-290-1932.

25-27—RadioComm '93, Metro Toronto Convention Centre, Toronto.

June

29-July 1—Utilities Telecommunications Council 45th Annual Meeting, San Antonio Marriott Rivercenter and Convention Center, San Antonio. Contact: Rita Clark, 301-621-7802.

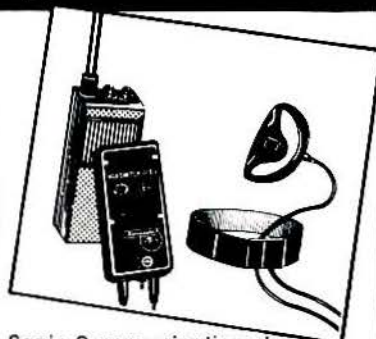
July

18-22—Forestry-Conservation Communications Association, Jackson, WY. Contact: Don Pfohl, 602-644-3166.

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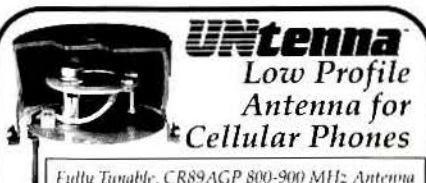
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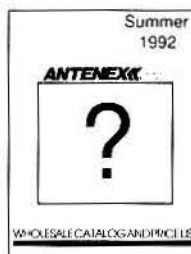
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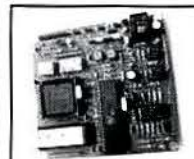
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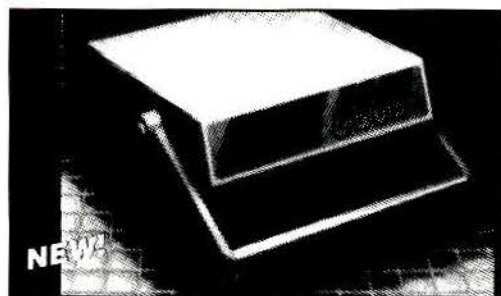
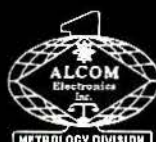
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- (Group 2) 46 ea - GE Multibank Rapid Chargers, Desk type - MAB - \$400/ea.
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- (Group 4) 1 lot. M-PD repair parts. Book Value \$1500, MAB - \$750

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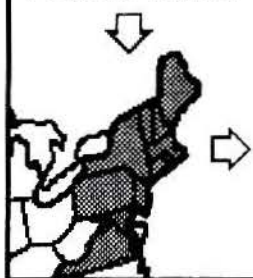
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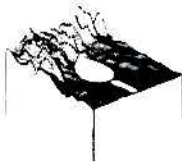
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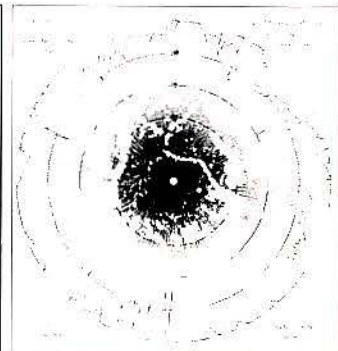
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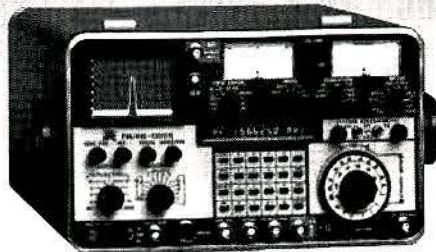
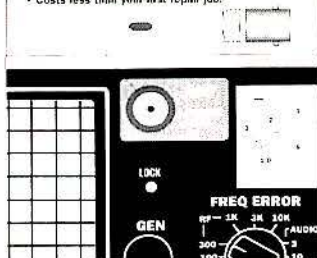
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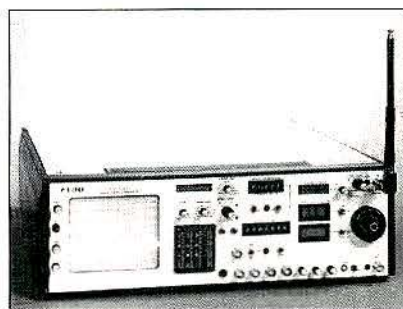
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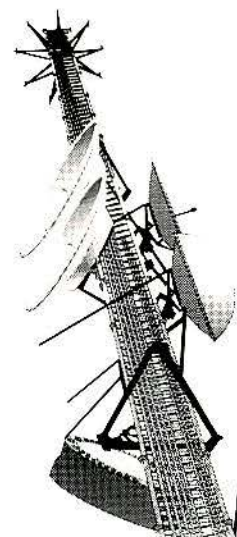
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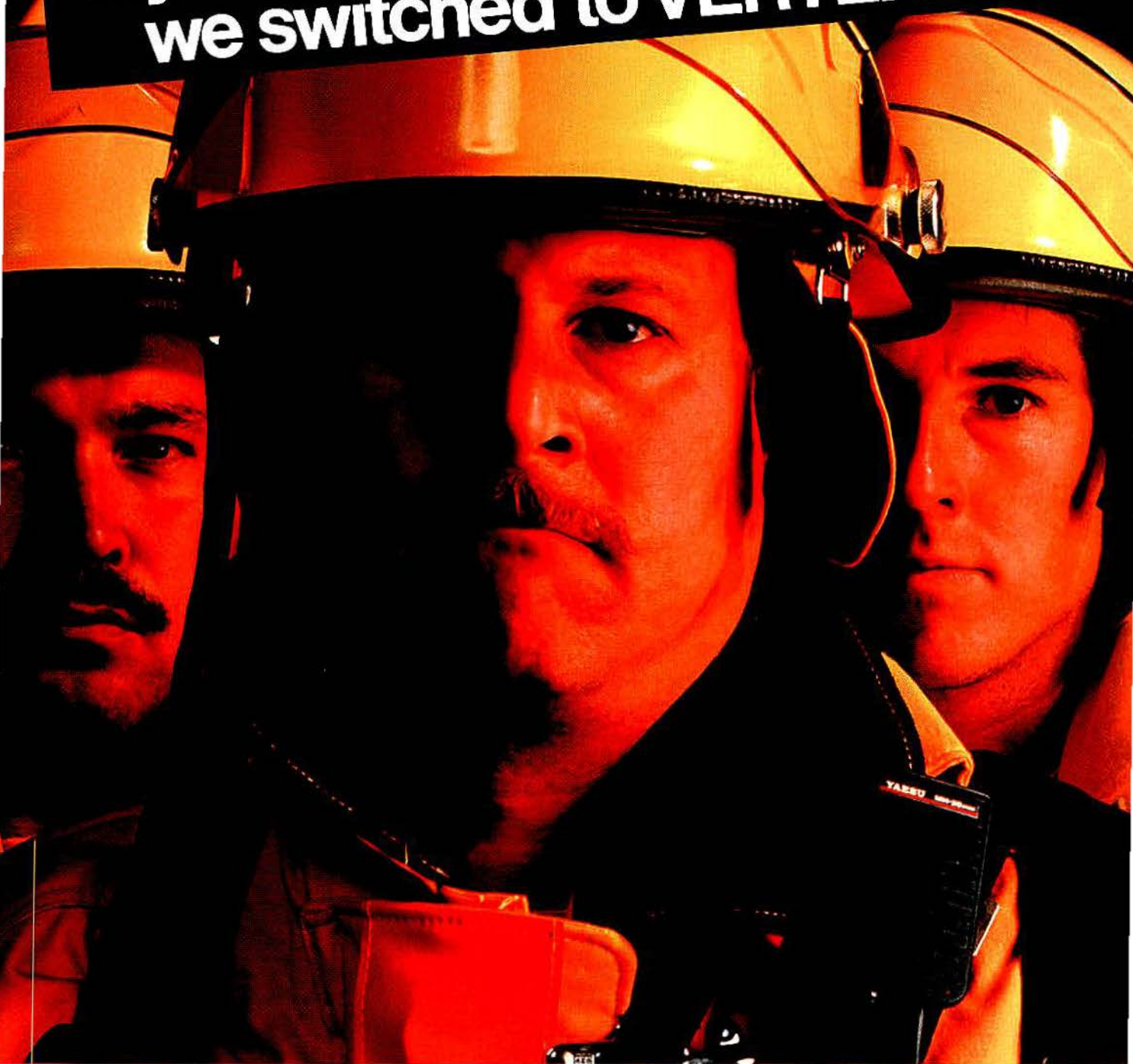
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California Radio	119		800-231-0103	Norton Engineering	132	160	703-938-5745
Carlson Communications	36	32	800-283-6006	Orbacom Systems Inc.	51	46	609-829-4455
Celwave	23	20	800-321-4700	PageTek Inc.	101		919-876-8294
Centurion International Inc.	9,126	9,149	800-228-4563	PanaVise Products Inc.	56	49	702-353-2900
C.E.T., Inc.	134	166	904-426-0014	Peacocks Radio & Wilds	125	141	800-232-7715
Channel Element Headquarters	124	139	800-237-9654	Pekkar Communication Inc.	127	152	201-772-0704
Changeguard Corp.	127	153	800-458-3410	Pipo Communications	127	150	916-644-5444
Cimarron Technologies	25	22	800-487-7184	Polaris Industries	118	128	800-752-3571
City of Fort Worth	124		817-871-7870	Polyphaser Corp.	113	113	800-325-7170
David Clark Co., Inc.	19	17	508-751-5800	Primus Electronics Corp.	110	109	800-435-1636
Coded Communications	15	13	800-228-6367	Primus Electronics Corp.	118,125	127,143	800-435-1636
CESCO	98	91	614-846-4733	Radio Express, Inc.	124	140	703-266-1928
Communication Instruments	133	164	800-288-8223	Radiomate	109,125	108,142	800-346-6442
Communications Associates	74,120	66,131	800-435-9313	Radio Wholesale	120	130	800-53-RADIO
Communications Data Services	132	161	800-441-0034	Ramsey Electronics	126	148	716-924-4560
Communications Specialists	BC	3	800-854-0547	RCW Distributing	122	137	800-726-9015
COMSEARCH	134	167	214-680-1000	RELM Communications	75	67	317-545-4281
COMTELCO Industries Inc.	92	85	800-634-4622	Ritron Inc.	79	71	317-846-1201
Connect Systems Inc.	46,48	42,44	800-545-1349	Rocky Mountain Comms Inc.	129		303-526-5454
Control Signal Corp.	14	12	303-989-8000	ROHN	30	27	309-697-4400
CPI Communications Inc.	96	88	800-869-9128	RTI Communications	106	103	318-234-3438
Curtis Electro Devices, Inc.	115		800-332-2790	Santa Fe Distributing	86	78	913-492-8288
Cushcraft/Signals Corp.	27	24	800-258-3860	Scala Electronic Corp.	85	77	503-779-6500
Cushman/KNS Electronics	133	165	408-432-8100	Schlumberger Technologies	13	11	800-225-5765
Cybersym Control Sys	132	159	703-268-5400	Securiton Company	100	94	408-263-6434
Datacom Inc.	60	53	217-222-0160	Setcom Corp.	24	21	415-965-8020
Data Signal Inc.	62	55	912-883-4703	Sharp Communication	122	134	800-548-2484
DB Mobile	59	52	800-388-2112	Shure	81	73	800-25-SHURE
Decibel Products, Inc.	41	38	214-631-0310	Siemens Solar Industries	28	25	805-338-6341
Doppler Systems, Inc.	113	112	602-488-9755	Sinclair Radio Laboratories	71	63	800-288-2763
DX Radio Systems	67	59	213-257-0800	Simrad Inc.	16	14	800-426-5565
Dynatech Tactical Comms	72	64	803-880-4411	Softwright	132		303-329-6388
Eagle Wichita	112	111	316-942-5100	Solar Electric Specialties	116	115	707-459-9496
EDX Engineering Inc.	90	83	503-345-0019	Solid State Communications	3	5	415-785-4610
Falcon Tower Fabricators	135	169	915-658-7155	Sonic Communications Inc.	116	116	603-878-1944
Fanon Courier	125	144	800-345-1354	Southern Computer Corp.	118	128	800-752-3571
Frametrack Ltd.	93	86		Standard Communications	57	50	800-767-6695
Freeman Engineering Assoc.	31	28	504-831-7785	STI-CO Industries Inc.	76	68	716-662-2680
Frequency Management	126	147	800-800-9825	TAD Radio	107	104	509-326-1511
Fryer's Site Guide	128	156	215-660-7804	TEAC America, Inc.	87	79	213-726-0303
General Communications	91,126	84,146	800-356-3200	Transcript International Ltd.	5	6	402-435-4400
GLB Electronics	108	106	716-675-6740	Trident Micro Systems	78	70	800-798-7881
Henry Radio	96	89	800-877-7979	Trilithic	89	82	317-895-3600
Hewlett Packard	32A-B,33	30	509-921-4001	Trylon Manufacturing Co. Ltd.	88	81	519-669-5421
Hustler Inc.	102,103	96,97	800-327-9076	TSR Technologies Inc.	38	35	703-552-8324
Hutton Communications	105	101	800-442-3811	TWR Lighting Inc.	135	168	713-973-6904
HY-Q International	119	129	606-283-5000	TX RX Systems Inc.	80	72	716-549-4700
ICOM America	45	41	206-454-8155	Uniden America Corp.	47	43	817-858-3300
IFR Systems, Inc.	63	56	316-522-4981	Unipage	17	15	800-367-2864
JaBRO Batteries Inc.	65	58	800-323-3779	VCP International Inc.	104,105	98,100	800-527-9366
JFW Industries Inc.	83	75	317-887-1340	Vega, A Mark IV Company	1	4	818-442-0782
Kenwood U.S.A. Corporation	49	45	213-639-4200	Vocom Products Corp.	68	60	800-USA-MADE
Kenwood U.S.A. Corporation	Bellyband		213-639-4200	Wacom Products Inc.	107	105	817-848-4435
Kyodo West Inc.	21	19	800-535-2082	WAVETEK	37	33,34	800-245-6356
Larsen Electronics	69	61	206-573-2722	W&W Associates	40	37	800-221-0732
Leathersmith	58	51	800-233-0440	Yaesu USA	IBC		213-404-2700
				Zetron Inc.	18,61,104	16,54,99	206-820-6363

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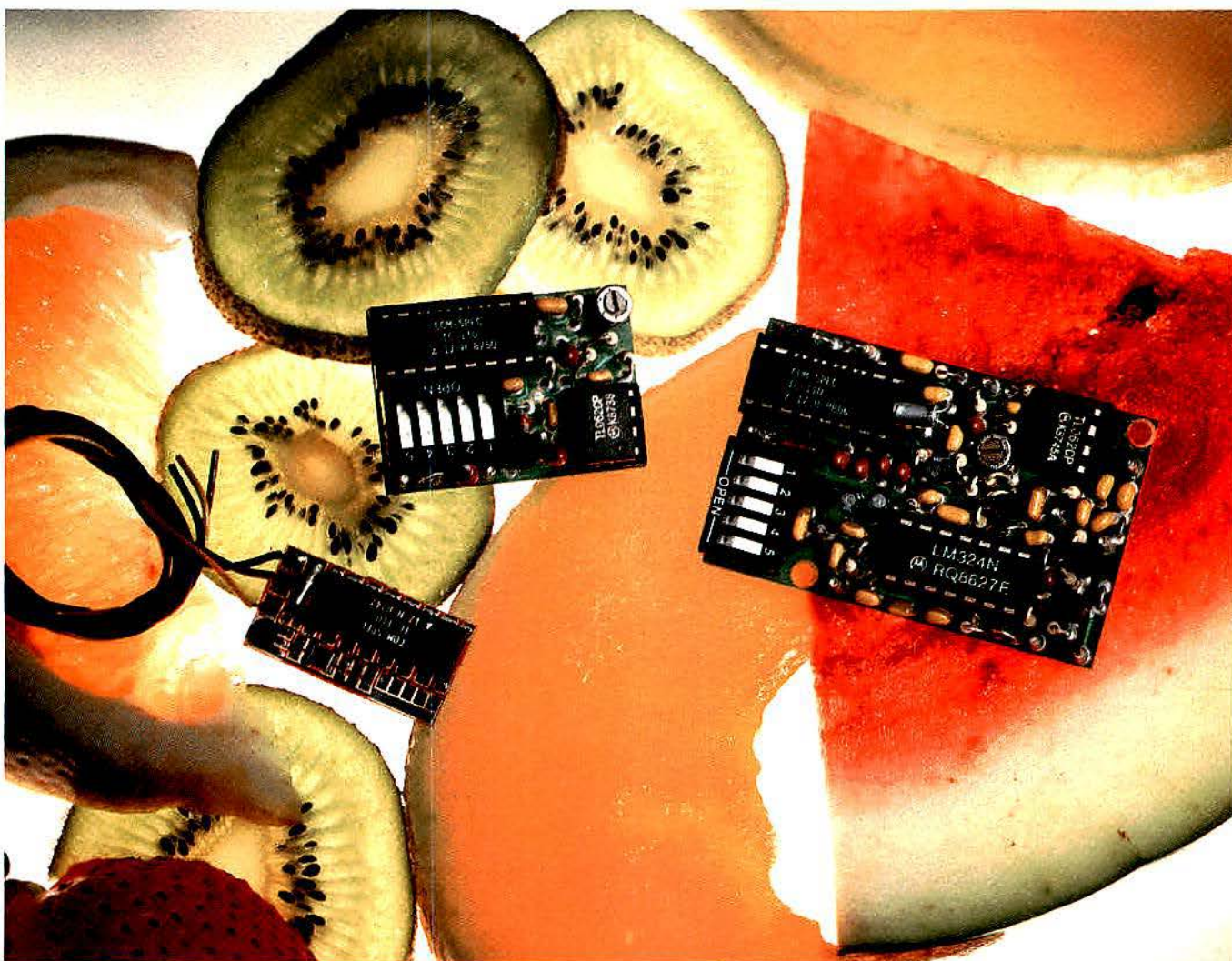
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